ELEMENTARY AGRICULTURE

WILLIAM LEWIS NIDA

A. FLANAGAN COMPANY

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FIG. 1. *Every stock farm needs its shade and water easily accessible.*

ELEMENTARY
AGRICULTURE

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Teachers' Edition

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PREFACE

IN taking up any new science it is well for teachers to secure the simplest text to be had in order that they may obtain a clear and well-grounded understanding of the subject before they attempt to interest pupils in it. This text is believed to be one of the clearest and simplest that has yet appeared in this field, and the publishers have therefore decided to issue an edition especially for teachers.

Since a much wider field of useful information about farming could be brought within this teacher's edition by using the question and answer plan, the latter part of this volume is composed of "One Thousand Questions Answered." They contain the most helpful points gathered from a wide reading in an agricultural library. It is hoped that by thus combining *Elementary Agriculture* with the *Thousand Questions Answered* we are able to offer to the teachers what might be called many books in one.

The book is so arranged and so carefully indexed that the teacher or farmer may easily find the information he is seeking. Morever there is nowadays such general interest in all questions pertaining to rural life and such widespread desire to follow the rally cry "Back to the Farm," that librarians are everywhere called upon to answer many questions and direct many readers on the subject. The very full index to this book, for which credit is due Miss Mary E. Collins, will be found helpful to the librarian as well as to the teacher.

WILLIAM L. NIDA.

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ELEMENTARY AGRICULTURE

PART I. FARM ANIMALS

CHAPTER I

THE HORSE

Taming the Wild Horse. Who tamed and rode the first wild horse and how he did it, we shall never know; but it was an important event for mankind. It happened long ages ago, before men began to write their doings in books. We know that horses lived in the time of the cave men, for we find remains of horses and rude pictures of them scratched on stone in caves and sand drifts. The cave men hunted these wild horses for meat and for their skins.

Variety in Size. The horse was then much smaller than he is now. He was about the size of a wild pony. The wild horses that came to live in mild climates where food was plentiful began to grow larger, with heavier limbs and stronger muscles; but those that passed into cold, bleak lands where food was scarce, grew small like the ponies of the Shetland Islands.

The Horse's Foot. The bones and fossils of the ancient horse show that he was once less than twenty-four inches in height. He had a spreading

foot with five toes. At that time he lived in low, marshy lands, and toes were needed to help him get about. As the earth became harder he lost one toe after another and so was able to travel faster to escape from his enemies. The horse's hoof is the nail of the one remaining toe.

Riding Horseback. The Greeks first drove the horse hitched to rude chariots, but later, it is said, they learned to ride him without saddle or bridle. They invented the first bridle bit, which is called the snaffle. Neither Greeks nor Romans shod their horses. At first only kings, nobles, and warriors could afford horses. They were used chiefly in war and for riding and driving in war chariots. But everybody who was able rode horseback; even kings looked upon this as the most dignified way to travel.

The First Work Animal. All this time the farmer had only the plow ox or the stubborn ass to help him raise his crops. When at last the farmer began to use the horse, he did his work much faster, for the horse has not only better speed and greater strength than the ox, but he can hold out longer.

The Horse and the Indian. Horses were not found in America when the white men first came. The Indians were greatly frightened when they saw the horses which the Spaniards brought over. They thought these animals were terrible monsters. But the Indians soon learned to use the horse, and, after a time, great herds of horses appeared wild on the western plains.

The Big Draft Horse. The time came when men began to breed horses for different uses. When they wished work horses that could draw very heavy loads at a slow pace, they selected the heavy, stout-limbed animals that had strong muscles; and by using these as parents they reared more like them. Gradually the colts of these horses grew stronger and larger, and so the draft horse was developed.

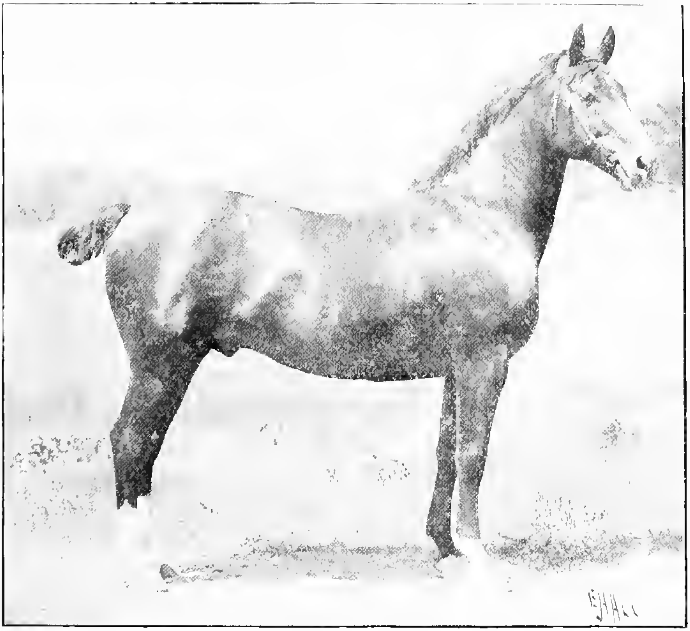


FIG. 2. *A coach horse.*

Coach and Roadsters. Other men wanted horses that could pull heavy coaches with good speed.

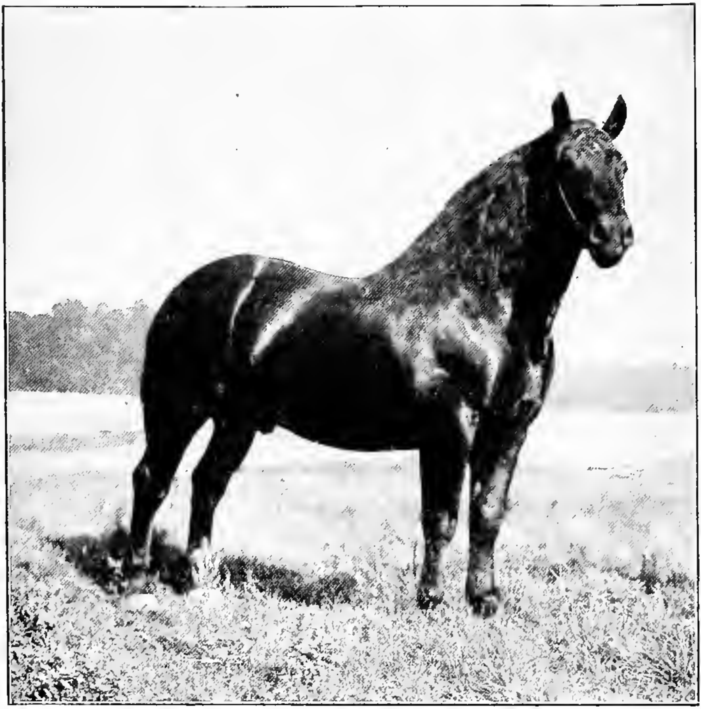


FIG. 3. *Percheron stallion.*

They wanted high knee action and fine style. So they kept this kind to breed from and developed the coach horse (Fig. 2). Still other men wanted speedy horses for light loads, and they reared saddle and race horses.

Kinds of Draft Horses. The draft horse is blocky, heavy, and powerful. He may weigh from fifteen hundred to two thousand pounds and is in much

demand for pulling great loads on city streets. He has a round body and rather short legs. His hind legs are the stronger, yet he uses his front legs so much in pulling that the front quarters are heavy and powerful. His breast is broad and his front legs far apart. From France we get the Percheron (Figs. 3 and 4) draft horse, with a gray, chestnut, or black color; from Belgium comes the bay Belgian; the Shire of bay brown or chestnut color comes from England and the smaller but more active Clydesdale (Fig. 5) from Scotland.

How to Hitch a Horse. When a team cannot pull a heavy load, it is often because the feet slip. The heavier the horse is, the better he can hold with his toes. A horse can really pull more on hard or slippery roads if he has a man on his back. This gives him more weight and a better foothold. One way to

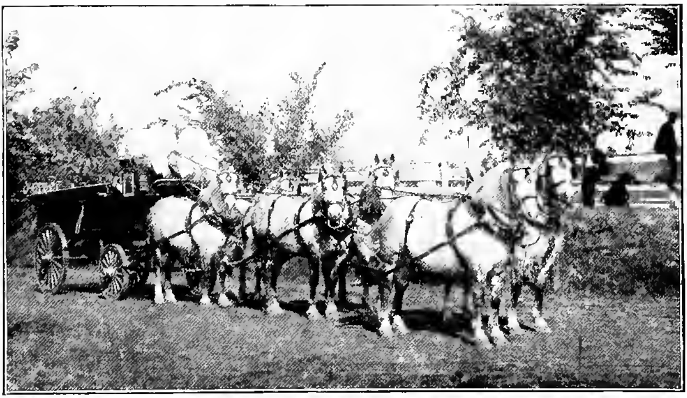


FIG. 4. *Prize six-horse Percheron team.*

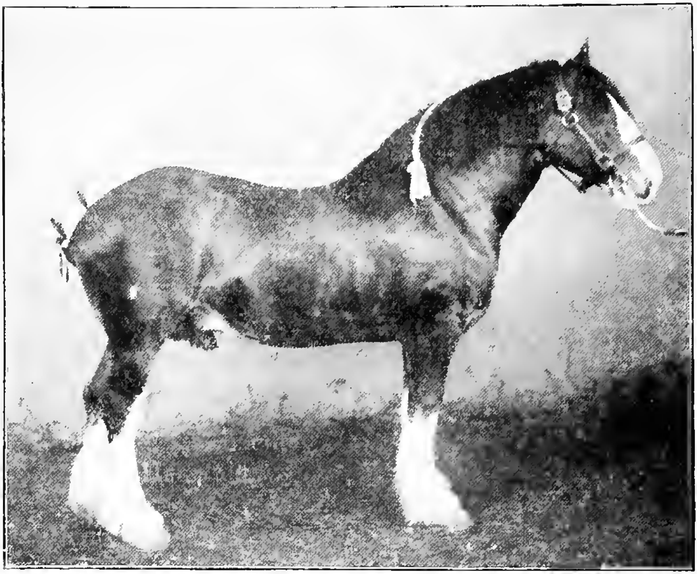


FIG. 5. *A Clydesdale.*

help a horse pull heavy loads is to put the whiffletree low down. It is better to have the doubletree under the tongue for heavy pulling. A farmer once tested this by hitching a horse to a post with a spring balance which would show how many pounds he pulled. When the whiffletree was tied six inches from the ground he pulled six hundred pounds more than when it was three feet from the ground.

Driving Fast. When a horse has a light load and is driven for speed, the whiffletree should be high. This makes the weight on the horse lighter so there is less strain on his legs and feet. Sometimes you

see in the city a two-wheeled carriage with the driver sitting high behind. This is called a hansom cab. The driver's weight makes the thills pull up on the horse and so carries part of the horse's weight. This saves his feet greatly in driving upon hard pavements.

Race Horses. The American trotter (Fig. 6) and the American saddle horse are the best of their kind in the world. Trotters have powerful hind legs and good lungs. They have small heads and large nostrils so they can breathe abundance of air (Fig. 7).

FIG. 6. *American trotting horse (Morgan type).*

Other Uses of the Horse. Among the Tartar tribes of northern and central Asia, mare's milk and horse-flesh are still used for the food of man. Old horses are always fattened for the meat markets of France and other countries of Europe.

Most Horses in America. To-day in Great Britain there is one horse to every twenty people; in France, one to every ten people; and in the United States, one to every five people. So we have more horses in America than there are in any other country, and we make them do more of our work.

Horse Power Cheap. Human labor costs more than any other kind of labor, so the farmer has learned to use his horses for many purposes. Years ago, when harnesses were poor and tools crude, many things were done by human hands that are now done by horse power. To-day one good horse can do as much work as ten men, while his board and keep costs about half as much as that of one man.

Doing Forty Men's Work. A farmer boy who drives a four-horse team hitched to a gang-plow is doing as much work as forty men working with hand tools. Four-horse plows and four-horse harrows are very common on the large farms in the West. Some of the great harvesting machines employ as many as twenty or thirty horses and mules on a single machine.

Feeding the Horse. A horse's stomach is small, so he cannot use as much bulky food as a cow. He

ought to have at least three good meals every day. When a horse is making long trips on the road he should not have too much hay, but a richer food, like corn or oats. The work horse should have his largest meal at night, when he has plenty of time to eat and digest it. If a horse is not warm, it is better to water before feeding him. The water passes on through the stomach and leaves room for the food. If an animal is very warm, it should

FIG. 7. *Thoroughbred trotting mares and colts.*

not be given either food or water until it has cooled off. Clover hay is not so good for a horse as timothy, because it is more dusty; and dusty hay is liable to give horses the heaves. If dusty hay must be used, it should be sprinkled before feeding.

A Good Variety. It is cruel to feed the horse on nothing but oats and hay all the year round, when

he would so much like some barley, beans, peas, corn, or turnips for a change. In the United States Army a horse is allowed ten quarts of oats a day. It is better to feed corn on the cob, as this makes the animal eat more slowly and it also improves his teeth. When carrots are given, they should be sliced to prevent the horse from choking. It is important to keep a little salt in his trough.

Cleaning the Horse. When a horse comes to the barn with muddy legs, they should be rubbed down or washed, especially in cold weather, to prevent rheumatism. Time spent in cleaning and rubbing the horse in the evening after the day's work is done, is much better for the animal than the same time spent in the morning, because the horse will rest so much better.

His Care. When a horse is warm upon stopping work in cold weather, he should be blanketed to keep him from catching cold. On very cold mornings the bits should be warmed by dipping them in water before bridling the horse. Even cold water will keep a frosty bit from freezing to the tongue and tearing the skin. Have you ever tried touching your tongue to frosty iron?

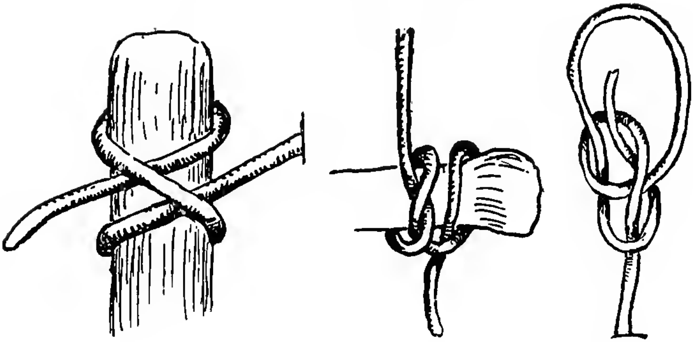
Healthy Shoulders. Many farm horses suffer from sore shoulders. This need not be so. The collar should fit and be kept clean. If there is danger of sore shoulders, they should be washed in salt water at noon and in the evening. Salt water is healing, and it makes the shoulders tough. When

the team is working hard, the harness ought to be removed at the noon hour. The horse should be well cleaned every day with a good brush. The curry-comb is harsh and painful, especially when used by rough hands.

A Pleasant Home. The horse's home or stable should be kept clean. It needs to be light, but the windows must not be where the horse will look into them, for this will injure his eyes, as it does yours when you sit facing a window. The horse barn should also have good air. If the barn is made very warm, a window should always be open where the draft will not strike the animals.

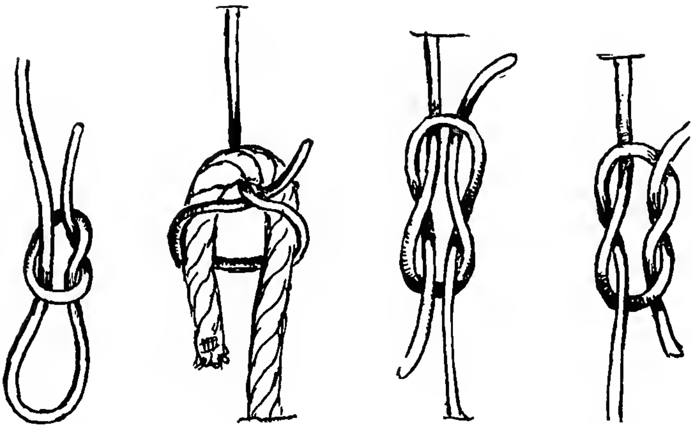
Shoeing the Horse. Many horseshoers do not understand their trade, and so they injure the feet of the horse. Sometimes they put on shoes that are too big, and this stretches the hoof too much. A very small shoe pinches and makes corns. Some pare the sole too much, and others even use the knife on the frog, which is a great injury to the foot. As the hoof is growing all the time, just as a man's finger-nails grow, the shoes need to be changed often, so they will not pinch the foot.

One Lesson at a Time. In breaking colts it is better not to try to teach them too much at one time. One of the first lessons is to "halter-break" the young colt. This should be done while he is still a suckling. A strong, well-fitting halter is placed on him, and he is tied short to a post near to his mother. A colt should always be tied firmly, for if



1 2 3

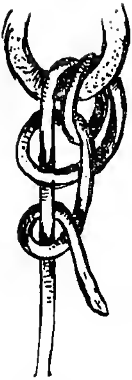
1. Clove hitch.
2. Picket rope with a half-granny and a half-hitch.
3. Bowline: a noose that never slips; is easily untied.



4 5 6 7

4. A slip knot, running noose, or halter knot.
5. Becket hitch for joining a cord and a rope.
6. Reef knot or square knot; never slips; easily untied.
7. False reef or granny; difficult to untie; a bad knot.

FIG. 8. *Knots that every*



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9

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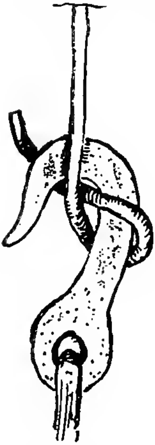
11

8. Anchor bend.
9. Fixed loop in middle of a cord.
10. Weavers' knot or sheet bend, for joining small cords.
11. Two half-bitches.



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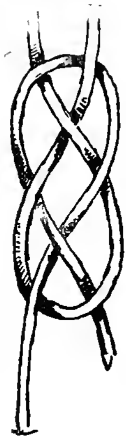

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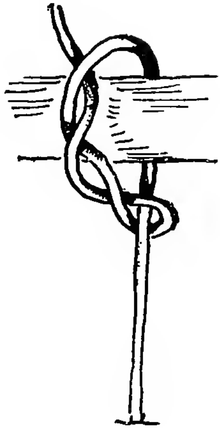

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12. Blackwall hitch.
13. Carrick bend for joining large ropes.
14. Timber hitch; cannot slip or jamb; easily untied.

farmer shou.d know.

he once breaks loose he has learned a very bad trick (Fig. 8).

His First Bridle. After the colt is halter-broken so he can be tied or led, it is a good plan to tie his halter to his mother's hame or collar. In this way he gets used to trotting beside another horse. The next lesson is to put on a bridle with a smooth bit. An open bridle is better than a "blind" one, for the horse ought to see everything about him so he will the more quickly get used to the new experience.

Driving the Colt. A saddle may now be put on, or a single harness with crupper and back strap. It is a good plan to drive the horse at first without a cart. The driver passes the lines through the tug or the loop made for the shafts, and in this way keeps the animal from whirling suddenly and getting tangled up in the lines. It is well to have a helper lead the colt at first, until he understands what is expected of him.

Driving Double. The colt may now be hitched to a cart with long shafts and a kick strap, or he may be hitched up with another horse. When this is done it is a good plan to keep a pair of single lines on the colt's bridle and have these in the hands of a helper. In hitching up double, it is well to use a heavy wagon with a brake and to put the colt on the "off" side. He can now be taught to stop, to back, and to start at the proper signal.

Not Too Many Signals. A horse should be trained early to stand still while he is being harnessed and

hitched up. Very few words or signals should be used, for a horse has far less brains than a dog. "Whoa" should always mean to stop. "Steady" is the word when we wish the team to go more slowly. "Back" should be used only when we wish the team to move backwards.

Kindness Pays. "The merciful man is merciful to his beast," and the well-treated horse repays his master's patience and good care. Horses, like all farm animals, should be kindly and gently handled. Jerking and whipping do harm to the horse, and this means a money loss to the farmer.

CHAPTER II

CATTLE

More Useful Than Horses. Horses are a great help to man, but we could get along without them better than without cattle. Cattle supply us with meat, leather, and milk; and they may also be yoked up for work.

Where Cattle Came From. Cattle have come down to us from a queer animal of the cave man's time, called the urus. In those far-off days there was also a kind of wild cattle. Some say the herds of wild cattle mixed with herds of the urus, and this mixture formed the cattle that we have. But nobody is very sure about this. We know that the cave man hunted and killed wild cattle for meat.

Taming the Wild Cattle. A long time after the cave man a higher race of men lived in villages built out over the edge of lakes in Switzerland. These people, called the Swiss lake-dwellers, seem to have tamed the cow. How do you think they did it? They probably kept cows at first for milk only. Instead of hunting all the time for food, the people began to give some time to their cattle and so became herders.

Churning the First Butter. Then a wonderful discovery was made by some one, and that was how to make butter from milk. Probably some lake-dweller

was carrying upon a journey a skin or leather bag of milk, and the motion churned the butter. Milk will not keep long without souring, but butter keeps much longer. The cow, with her milk, butter, hide,

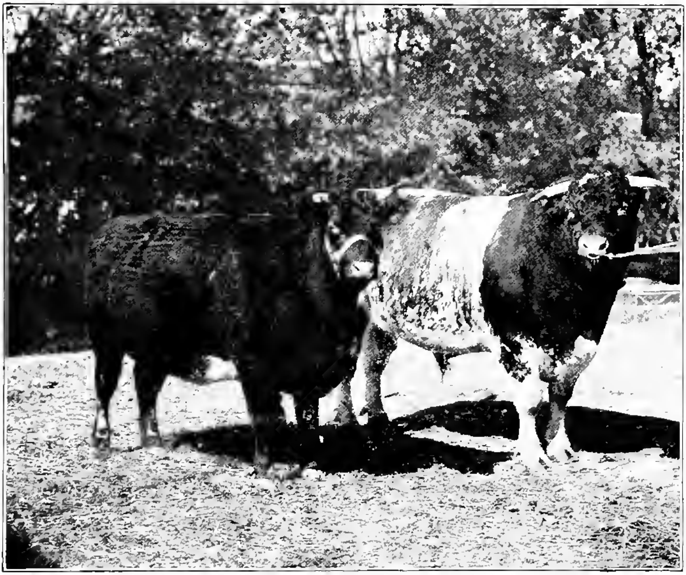


FIG. 9. *A beef breed (Shorthorns).*

and meat, must have done a great deal to help these ancient people to better ways of living.

Hitching Cattle to Loads. We do not know when cattle were first yoked up and hitched to loads. Perhaps a cow was tied by a leather thong, when suddenly she made off through the woods, dragging a man or the log to which she was tied. Then some

one hit upon the idea of tying a cow to anything he wished to have moved.

The First Plow. After the yoke was invented, some clever person made a rude plow of sharp sticks tied with thongs, and agriculture took a long step forward, because this enabled the farmer to use animal power to till the soil, instead of doing it all by hand.

Two Kinds of Cattle. Cattle were early brought to America from Europe. Men began to want two kinds of cattle, one for milk and butter and the other for beef. They found that a good milch cow is not very good for beef, for her food all goes to milk; while a fat cow will not give much milk, as her food makes flesh or muscle. By carefully selecting the good milkers for mothers, farmers have developed a fine dairy animal, such as the Jersey, the Guernsey, or the Holstein.

Beef Cattle. Other cattle raisers have bred from the large, heavy animals and have herds of fine beef cattle, such as the Shorthorns (Figs. 9 and 17), Herefords, or Galloways (Fig. 10). The beef cow is square, with all bones well covered with flesh. Her back is straight and her legs full and thick. The neck is full and stocky, the legs short and set far apart to support the large, heavy body. The more meat these animals can make from a given amount of food, the more profitable they are.

Their Care and Feed. Beef cattle need different food and care from the dairy animals. The beef

type do not require such warm barns as the milkers do, because fat animals never need such warm housing as do lean ones. They seem to do better in dry, open sheds that are well bedded. They need such foods as will make them fat most quickly and at the least expense, and cattle feeders know this well.

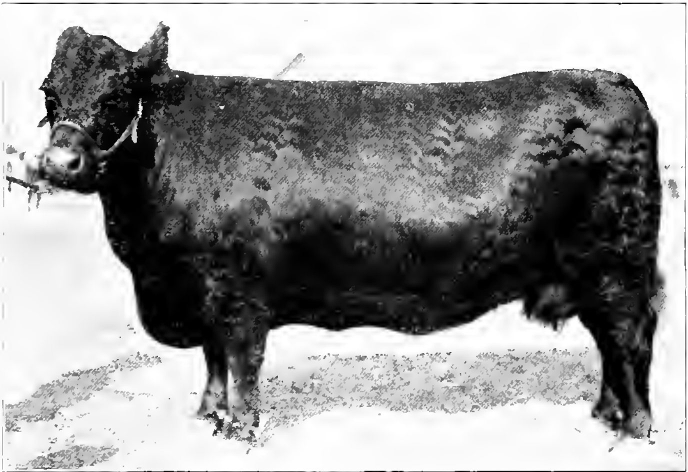


FIG. 10. *A Galloway cow.*

Getting Ready for Market. Sometimes calves are fed fattening foods as soon as they can digest them. They are kept on such food until they are ready for the market at from ten to sixteen months of age. Other cattlemen give their young herd the freedom of the range or pasture for a few months, or, perhaps, for a year or two, and then put them on rich,

FIG. 11. *An empty dinner pail.*

fattening foods for a few months before they are sold to the butcher or the packer.

Feeding Meal. When teaching a young calf to eat meal, the farmer puts him in a box stall with another, older calf, and the young one will learn from his companion. Another way is to take a little meal in the hand and put the hand in the mouth of the young calf. (Fig. 11.)

A Mixed Food. A good meal ration for calves is a bushel of ground corn, a bushel of ground oats, a peck and a half of wheat bran, and the same of oil meal, all well mixed. As soon as calves will take hay or fodder, it should be given to them. They will begin to nibble and taste it when two or three weeks old. The best hay is clover, alfalfa, or cow peas. As soon as they begin to chew the cud, finely cut hay is mixed with the meal. In this way one can prepare the calf for weaning. (Fig. 12.)

Saving Cream. When calves are fed on skimmed milk they miss the butter-fat that has been taken away as cream. In its place the farmer feeds the calf some corn meal or linseed meal. One or two cents' worth of meal will serve the calf as well as twenty-five cents' worth of cream.

Choosing a Good Dairy Cow. The dairy cow is shaped like a wedge. The neck, thighs, and shoulders are thin and lean. She should be thin, not because she is poorly fed, but because she is turning a large part of the feed she eats into milk. She should be quiet and gentle. She should be strong and have room for a large quantity of food. Her hips are prominent and wide apart, and the rump is high. The hind legs are trim and set well apart.

FIG. 12. *Where are our mothers?*

Most important of all, she has a large, well-shaped udder. The floor of the udder is straight and extends well forward and well backward, too. The

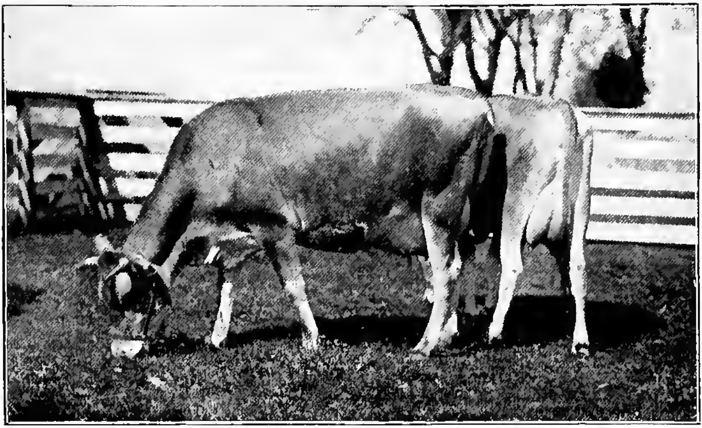


FIG. 13. *The dairy type (Jerseys).*

udder is soft and fine. The teats are evenly placed and of medium size. The buyer should milk out a few streams to see that the openings are not so small as to make her a hard milker. The milk veins which extend forward from the udder should be large, with many branches, because they supply the blood from which the udder secretes the milk.

The Jersey Type. The Jersey cow (Fig. 13) is famous the world over for her rich milk. These cows were the first dairy animals to become popular in our country. They change a large part of their food into milk instead of into flesh or fat. Jersey milk is the richest of all. The Jersey heifer matures

early and may become a mother at between two and three years. So the dairyman does not have to feed her long until she more than pays her way. This breed came, in the first place, from Jersey Island, in the English Channel. The island is only eleven miles long by five and a half wide, but it is very rich and productive; and the farms there are very small, sometimes not more than two or three acres. The principal industry is dairying, and the stock has been kept pure by forbidding foreign animals to be brought in. The milk is nearly all made into butter.

The Guernseys. The Guernsey cows, like the Jerseys, come from one of the islands by that name in the English Channel. They are somewhat larger

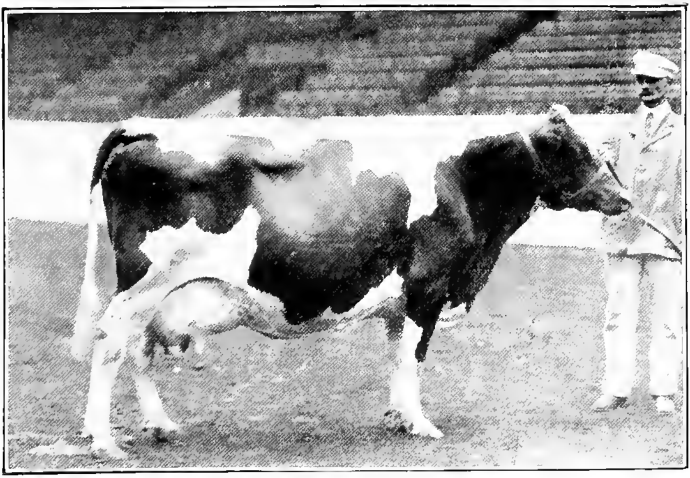


FIG. 14. *A record cow (Holstein).*

than the Jerseys. They have coarser bones and carry more flesh. Guernseys are noted for their yellow milk, which is only second to that of the Jersey in richness. But they often give a greater amount than the Jersey.

The Holstein. This dairy animal was bred 2,000 years ago along the Rhine, in Europe. The Dutch first brought these cows to America, shortly after the settlement of New Amsterdam. The Holstein (Figs. 14 and 107) is noted for the great amount of milk given. The milk is not so rich in butter-fat as that of the Jersey or Guernsey, but the large amount makes her a most desirable cow to keep near large cities like New York, where the milk is sold by measure. Other noted dairy types are the Ayrshire, the Brown Swiss (Fig. 15), and the Dutch Belted.

The Babcock Milk Test. For a long time dairymen did not know how to choose the cows which gave the richest milk. Not many years ago Dr. S. M. Babcock, of Wisconsin, invented a machine to test milk for the amount of butter-fat. Now every farmer may know which cows are valuable for their rich milk and which ones are not worth their keep.

What a Good Cow Produces. A good cow should produce from twelve to fifteen pounds of butter a week. One of the highest records ever made was by a Holstein cow that made thirty-three pounds of butter in one week (Fig. 14).

Caring for the Dairy Cow. Twice each day the dairy cow is driven to the barn to be milked, and the more milk she gives to each pound of food, the more valuable she is (Fig. 16). In order to give an abundance of milk, she must have the best of care and food, and kind treatment; and she must be milked at regular hours. She should have water and plenty of good food at every meal time.

Their Food. In summer, when the cows are in

FIG. 15. *Brown Swiss twin calves, bull and heifer.*

pasture, they need very little other food unless the pasture becomes short and dry. Then corn, alfalfa, peas, oats, rye, or some other crops may be cut green and fed to them. Water and shade should be within reach of cows at all times in hot weather (Fig. 1). In winter they like hay, root crops, and silage.

A Balanced Feed. It is best to feed some dry hay or fodder, some silage or green food, and some grain. The careful dairyman always feeds just the right amount of each to supply what the cows need without any waste. He calls this a "balanced ration."

Testing Cows. Some pure-bred cows are poor milkers. The only way to make sure that a cow is worth her board is to test her milk for butter-fat and weigh the milk. Every dairyman should keep a record of each cow for one year. A spring balance with a paper beside it will enable the farmer to weigh the milk and put down the amount quickly.

An Easier Way. Or, instead of weighing the milk every day, the farmer may weigh the milk of each

FIG. 16. *A row of money makers.*

cow for three days each month. The sum of these weights multiplied by ten will give the year's production. Take samples for the Babcock test in the second, fourth, and seventh months after the cow freshens. If you add these and divide by three you get the average daily production of butter-fat.

Cow-testing Associations. Dairymen who find it

FIG. 17. *A Shorthorn bull.*

difficult to test their own cows are in some instances banding together in cow-testing associations. To this association each farmer contributes a small fee and with this money an expert is employed who spends his time going about among the dairies and testing the cows of each herd. This plan has been used in Holland for many years, and is the reason for the great advance in the dairy business in that

country. Farmers who desire to form such an association should write to the Department of Agriculture, who will send a man to assist in forming the organization.

Uses Made of Beef Cattle. It is said that every grown person in the United States eats, on an average, one hundred and fifty pounds of meat in a year. The greater part of this is furnished by the great herds pastured on the Western plains. Leather for many purposes is made from the hides, and butterine is a product of the fat or tallow of beef. Buttons are made from the bones; combs, from the bones and hoofs; and glue, from the sinews, bones, and hide trimmings.

How to Get Good Stock. The cheapest way for a farmer to build up a fine herd of either dairy or beef cattle is to save only the calves whose father or sire is a pure-bred animal. (Fig. 17.) There is a true saying among stock farmers that "The sire is half the herd." The way to improve a scrub herd is to obtain a pure-bred sire. The first calves are half pure. When these calves become cows and mothers, their calves are three-fourths pure stock, and so on. Scrub cattle have no place in the fields of a good farmer.

CHAPTER III

MILK AND BUTTER

Milk as Food. Milk is a good food for every one. The Laplander milks his reindeer, and the Arab his camel. The people of India milk their buffaloes, and the mountain people their sheep. A quart of cow's milk contains about the same amount of food as three-quarters of a pound of beef. Thus we see that milk is cheaper than meat or eggs. As the cities grow there is a greater demand for milk, but the buyers insist that it be clean.

Keeping Milk Pure and Clean. Milk absorbs or takes up odors. If a cow is fed cabbage, onions, or turnips a few hours before she is milked, you will notice the flavor of those vegetables in the milk. Milk that stands uncovered in dirty barns has the odor of the stables. Therefore, the barn must be clean and light, with plenty of windows to admit the air, and the cows should be fed proper food. They should always have pure water, because milk carries many germs, especially those of typhoid fever. Feeding should be done after milking, so the air will not be full of dust to settle in the milk.

Milking the Cows. The udders of the cows must be washed, and the milker's clothing and hands should be clean before a drop is drawn. All pails and vats for holding milk should be thoroughly

washed with warm suds and then rinsed with scalding water. As soon as milk is drawn, it is well to cool it to stop the growth of the germs that cause it to sour.

Butter-fat. If we look at a drop of milk through a microscope we shall see many tiny, roundish bodies with a pearly look floating in the fluid. Fifteen thousand to twenty-five thousand of these little bodies placed side by side will measure an inch, and there are millions of them in a drop of milk. These particles are the fat of the milk, from which butter is made. They are lighter than milk, and when milk stands for a time they float upward. With some of the milk on top of the pan they form the cream.

Ready to Churn. After the cream is removed by a skimmer or the new hand-separator, it should stand until it ripens, or sours. It is most easily churned at a temperature of from fifty-six to sixty degrees Fahrenheit. The room should be, as nearly as possible, the same temperature as the cream.

Churning. When this cream is put into a churn and dashed about, the little particles of fat hit together and stick to one another until they unite to form small pieces of butter about the size of a grain of wheat. Then we can see the butter-fat in the buttermilk.

Preparing Butter for Market. When the butter is gathered from the churn, it may be washed to remove part of the buttermilk. Then the whole butter mass

is pressed together and rolled with a wooden paddle to remove the rest. Three-fourths of an ounce of fine table salt should be added to each pound of butter and evenly worked into the butter mass with the paddle. The worker firmly rolls and presses the butter, but does not rub it, because that destroys the grain. When the butter is free from buttermilk, it can be made into a tempting lump and stamped and rolled in oiled paper. Butter is judged for its flavor, color, grain, and the amount of salt, but in a great measure it is judged by its general appearance.

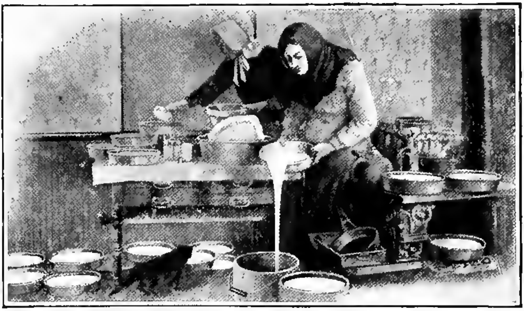


FIG. 18. *The old way of separating cream.*

FIG. 19. *The new way—cream separator.*

The Churn. Farmers, to-day, prefer the barrel churn, without a dasher. In operation this churn throws the cream back and forth against its sides. Churns

should never be filled more than half full. Butter-making is greatly aided in late years by the use of the separator and butterworker (Figs. 18 and 19).

Cheese-making. Cheese may be made from cream, skimmed milk, or the whole milk. Most of the cheese we buy at the store is made from the whole milk. Years ago our grandmothers made cheese as commonly as they did butter, but cheese-making is such a long process that to-day it is done in creameries or factories. Cheese is the solid part of the milk in such form as will keep for long periods. A little difference in the process of the making, produces a different sort of cheese. One book tells us of one hundred and fifty-six different kinds. They are usually found in three classes—hard or soft cheese, cream cheese, and sage cheese.

Cottage Cheese. Cottage cheese is a home product made by heating sour milk, which has thickened, to the point where the curd separates from the whey. The whey is drained off through a cheesecloth, and the dry curds are seasoned with cream and salt. A great deal of this is sold on the market for table use.

By-products. The by-products of the dairy are skimmed milk, buttermilk, and whey. These are chiefly used in feeding young animals on the farm, because it costs less to ship fat stock than it does feed or milk. The curd of the milk is dried in large factories and ground fine and used in the sizing of paper. Milk sugar is made largely from whey. This

is much used for babies and invalids. Other foods and drink which are becoming popular are made from the dairy. Up to 1850 the dairy work was all done and marketed from the farm. Now the milk is largely taken to creameries and factories, and butter, cheese, and condensed milk are manufactured there.

CHAPTER IV

SHEEP

Wild Sheep of Asia. On the plains of Asia there may be seen to-day small flocks of wild sheep. They are larger than our common sheep, with such immense horns that it would require a foot line to reach around one at its root and a four-foot line to measure their length. The wool of the wild sheep is brown, with a buff-colored streak along the back. These wild sheep are strong, quick, and suspicious, so they are very hard to catch. They are hunted for their flesh and their skins, which are made into clothing. They have a coat of fine soft wool to keep them warm, and over this is a long coarse hair, which serves as a raincoat.

Another Kind of Wild Sheep. In the mountains of Greece is another type of wild sheep, smaller and less active than those of Asia. It is believed that our domestic sheep have come from one or the other, or perhaps both, of these wild types.

Taming the Sheep. Some writers think the sheep was tamed before the horse or cow, because they were small and could not defend themselves so well. Sheepskins made fine clothing for the cave man. The first animal we find mentioned in the Bible is the sheep, but the Bible mentions other domestic animals.

Where Sheep Live. The sheep can live on rough hillsides and mountain cliffs where other domestic animals would starve. They thrive best in cool climates, because of their heavy coats of wool. They require less grain and will eat more kinds of food than the horse or cow. So they are more easily cared for (Fig. 20).

The Use of Sheep. A flock of sheep increases very rapidly, for ewes, or mother sheep, often bear twin

FIG. 20. *A good animal eats no more but pays better.*

lambs every year. The lambs become full-grown in a few months, and their flesh makes excellent food, while the fleeces make woolen clothes for the people of many lands. When prices of wool are fair, a good ewe will pay her board and keep through the year with her fleece. The flesh of the sheep is worth about half as much as the wool. If she raises two lambs they are clear gain to the farmer. Sheep have no equal as weed-destroyers, for they eat nearly every weed that grows on the farm. In small numbers they build up and enrich the land, for sheep manure is worth more as a fertilizer than

that of any other farm animal except poultry. A few sheep will pay their way and make money for their owner on any farm that is not wet and marshy. They will not thrive on low, moist land. Aside from their fleece and mutton, the bones are used for fertilizer. The skins make leather for boots and shoes. The tallow is made into candles, and the skins of the intestines are made into strings for musical instruments.

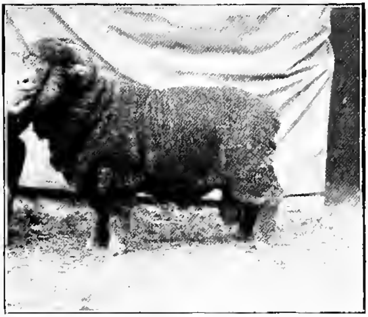


FIG. 21. *A Merino ram.*

Two Kinds of Sheep. We raise two types of sheep, because those that produce the best wool do not make the best mutton. If a farmer is raising sheep for mutton mainly, he keeps a herd of Shropshires or Southdowns or some other mutton type. If he is chiefly interested in growing fine wool, he keeps American Merinos or some breed like them.

Merinos for Wool. The oldest races of the domesticated sheep are probably the Merinos (Fig. 21). They were very likely kept in Palestine in Bible times, and it may be that King David when a lad kept watch over a flock of Merinos. They came to America from Spain and have been greatly improved by American farmers. They are the best

wool-producers, yielding heavy fleeces of very fine wool that is used to make the finest and most expensive woolen goods.

Thrive in Large Flocks. Though the Merinos are not so hardy as the wild sheep, they are hardier than any other of the domestic breeds. They will thrive in larger flocks than any other kinds, so they are used in the range country of the West. They have a long life and grow good fleeces to a ripe old age, while the fleece of the mutton type begins to lose in weight at an early age. Sheep on ranches of our Western states are kept a thousand or two thousand in a flock and sent off in the summer with a herder and a shepherd dog. If the herder has a horse, he sometimes cares for five thousand in a flock. One rancher often owns from twenty-five thousand to fifty thousand sheep. The cattle men object to large flocks of sheep, for they eat the grass so close that other animals cannot be grazed there. Cattle also dislike the odor left by sheep.

FIG. 22. *A Shropshire ram.*

The Shepherd Dog. The shepherd dog, or collie, tends the flock and rounds them up when they stray. He watches them at night and keeps off the mountain lions. These dogs are very intelligent. They obey

the voices and spoken commands of their masters, and even understand signals of the arms.

Care and Fleeces of Sheep. The Merinos stand more neglect than other sheep. They can get through the winter on good straw, a little grain, and some hill pasture. However, their mutton is only fair, and they do not raise as many lambs as other breeds. Their bodies are covered with large folds or wrinkles of skin that make shearing difficult, but these very wrinkles only make so much more surface for good wool to grow on.

Sheep for Mutton. Shropshires and Southdowns are the best liked of the mutton types in America. The Shropshires (Fig. 22) have nearly black faces and legs, and no horns. They rear more lambs than other kinds, but their wool is not so fine as that of the Merinos. Mutton sheep are profitable even on high-priced land, if it is near a good market. Fancy lamb mutton is a delicacy that people like and are willing to pay for. Southdown ewes (Fig. 23) usually rear two lambs each year, and they are good mothers.

Some Dogs Kill Sheep. Two difficulties have stood in the way of sheep-raising on a small scale. These are expensive fencing and dogs. Sheep must have better fences than cattle. Wire fences keep stray dogs from chasing the flock at night and killing many sheep, but until lately wire fences have cost so much that very few farmers could afford to use them.

Food for Sheep. Sheep are naturally grass-eating animals, for nature seldom fed them any grain. So they are prepared for bulky food. In England they seldom taste grain. They are fed on pastures, hay, and roots—mainly turnips. In changing the

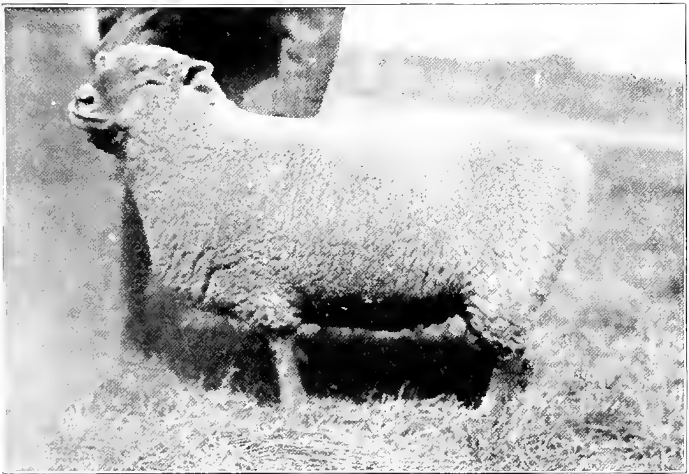


FIG. 23. *A prize Southdown ewe.*

food of sheep, we should do so very gradually. Usually lambs are simply put on pasture during the summer months and sold before it is necessary to house them for the winter. Some Western sheep growers put their lambs on the range to run free from eight to twenty months. Then they are shipped to Eastern farms to be fattened for market. Here they are fed corn, clover, or mixed hay and, perhaps, oats, peas, or barley. The best pastures for

sheep in the corn belt are clover and alfalfa. They need shade in their fields to protect them from the hot sun until shearing time. (Fig. 24.)

Fattening Lambs. Sometimes when lambs are fattened for the market, they are "forced." This means that they are fed rich food from their birth until they are ready for market at from six to ten weeks. These are called "hothouse" lambs, and they furnish the finest quality of mutton to be had. They need good housing and extra care.

Weaning Lambs. A pound of flesh can be put on a baby lamb at much less cost than when he is older. Nothing is better for them than mother's milk. Some are allowed to run with their mothers until they weigh seventy or eighty pounds, when they are to be sold as mutton. Lambs that are to be kept on the farm should be weaned when ten or twelve weeks old. (Fig. 25.)

Shepherds. No lad who is rough or brutal with animals should be put over a flock of fine sheep. If he loses his temper and abuses his flock, they will not do well, for they are peace-loving animals. The good shepherd is always kind and gentle. He keeps his feed troughs clean, he feeds by the clock, and he feeds plenty of a good, balanced ration. He keeps salt and pure water where the sheep can get them, for it is a mistaken idea that sheep do not need water. The shepherd that allows maggots or ticks or lice to trouble his flock in hot weather is not worthy of the name.

FIG. 24. *All farm stock need shade.*

Shearing Sheep. It takes several seasons for a man to become a good sheepshearer. A good shearer will take the wool from sixty to eighty sheep a day with common hand sheepshears. Shearing machines, which are sheepshears attached to a long rod and managed by power, are now very common. The sheep is turned into a narrow alley and in a few minutes he comes out without his coat. It is far easier to shear with the machine than by hand.

FIG. 25. *Dorset ewe and lamb.*

Though a practiced hand can shear almost as fast as a machine, beginners can shear twice as fast with the machine. The machine takes off the fleece

smoothly and evenly without any ugly cuts. It saves from two to eight ounces of wool. The sheep should not be sheared too closely with the machine; enough wool should be left to protect the animal from flies and sunburn. Most shearing is done in June, but some sheep-raisers advise shearing twice a year—in April and in August. It is better for the sheep to be relieved of the burden of the wool in August, though the fleece is shorter and not so valuable. After shearing, the sheep are sometimes made to swim through a cleansing bath, which keeps their skins in good order.

Land Suitable for Sheep Farms. There are many farms in the Eastern states of our country that are well suited to sheep-raising. Some of these farms are too poor for crops, but they would make good sheep farms if several of them were put together, for sheep need a large range of pasture. In New England high and rocky land suitable for sheep-raising can be bought for a very low price.

CHAPTER V

SWINE

The Wild Boar. Long ages ago there roamed through the forests of Europe herds of fierce, wild boar. They usually ate fruit, roots, and grass; but when they were hungry they ate snakes or fowls or fish. Perhaps they sometimes devoured men whom they found weak or disabled. They were dangerous beasts. To hunt them with nothing but clubs and bows and arrows required great courage.

Taming the Wild Beast. But somehow the brave men who then dwelt in the forests, after killing wild boars for meat for many years, set out to tame this ugly beast. And they did it, too, but they never left us a word to tell us how it was done.

Improving the Hog. By carefully choosing and keeping the best hogs, the farmers have made the fine breeds of to-day quite different from the fierce wild boar. The wild hog did not take on fat, but our domestic breeds will fatten in a remarkably short time. They sometimes become too heavy for their legs to support them. The legs have become shorter than those of the wild boar, the snout and neck are also shorter, while the shoulders and hams have come to take on flesh marvelously.

Protecting Hogs. The hog has very little covering for his body, for the few bristles and hairs do

not protect him from the swarms of flies. The hog never perspires, so in order to keep cool, this animal should be kept in shaded pens or where there is water in which to wallow. Those that are kept in woods or groves do not need the wallow so badly save to protect them from flies.

Giving Hogs a Square Deal. Swine have always been looked upon as filthy animals. In ancient times Moses was taught to have his people abstain from eating pork, because it was said to be unclean. This is rather unfair to the hog, for when he is provided with large yards, he keeps his bedroom clean. "It is only when the small pen is made to serve as dining room, bedroom, and wallow, all in one, that the hog is filthy. That is not his fault." It is the way in which the farmer forces him to live.

Their Useful Snouts. Hogs have to dig for some of their food, and so they have tough noses with a sort of disk or shovel on the snout for that purpose. Since they use their noses to dig for roots that they like, we use the name "rooting." It is said they have a keen sense of smell and can be led by it straight to their food. The pig can follow a trail almost as well as a dog.

Best Breeds Developed Here. Hogs, like most other domestic animals, were brought to America from Europe. Most of the best breeds of hogs have been developed here. The Poland-China (Fig. 26) was developed in Ohio; the Chester-White, in Pennsylvania; the Duroc-Jersey, in New York and New

Jersey; and the Cheshire (Fig. 27), in New York.

Two Kinds of Hogs. Some hogs are raised for lard and others for bacon. Corn is good food for hogs that are grown for lard, and so the lard type is the most common and the most profitable in our

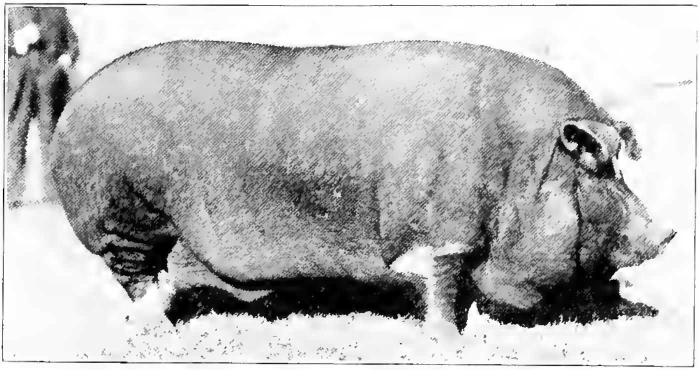


FIG. 26. *A prize Poland China.*

country. In England, the bacon type is raised. Some hogs are useful for both purposes.

The Kind to Raise. The hog yields meat at a lower cost than any other animal when he is well cared for and properly fed. One should not raise scrub hogs, which are sometimes called "razor backs." It takes two years to get a scrub to weigh as much as a well-bred pig will weigh when nine months old. If a farmer has only scrub stock, he can improve his herd in a very few years by the use of a pure-bred sire.

What They Eat. When hogs are free to roam the woods they eat roots and such nuts as acorns and

beechnuts. They will eat almost anything, whether it is meat or plant (Fig. 28). It is said they once did great service by devouring rattlesnakes on the frontier.

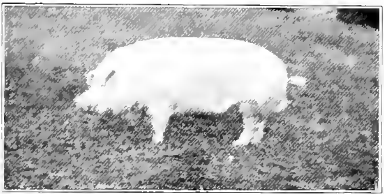


Fig. 27. A Cheshire pig.

Hogs in the East. There are two ways of raising swine common in our country. In the East each farmer keeps a few hogs in small pens or yards and feeds them the waste from the kitchen and farm. Such hogs are usually kept for home use.

The Western Hog Farm. In the Corn Belt of the Central West there are great hog farms. Hogs are often raised on farms where cattle are fattened for the market. Here both hogs and cattle are fed on corn. The hogs run with the cattle and grow fat on the corn which the cattle waste. Where hogs are put on pasture they grow rapidly on clover, alfalfa, or rape pasture (Fig. 29.)

Fig. 28. Good feeders.

A Dreaded Disease. There is one disease which the hog raiser dreads, because it often destroys an entire herd in a few weeks. This disease is the hog-cholera. When the animals live all together, the disease spreads very rapidly. In some places farmers are putting their swine in small pens, or houses called "colony houses," scattered about the fields. In each colony there are from six to eight hogs. If cholera appears in one of these separate houses, it can be burned so as to prevent the disease from spreading.

A Pig Sends a Boy to College. "A boy, whose parents were too poor to send him to college, once decided to make his own money and get an education. He bought a fine sow and began to raise pigs. His hogs increased so rapidly that he had to work hard to keep them in food. By saving the money he received from the sale of his hogs, he had enough to keep him two years in college."

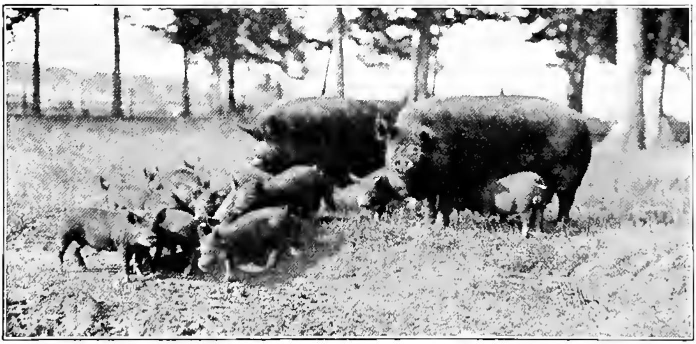


FIG. 29. *Berkshires on clover.*

CHAPTER VI

POULTRY

The Original Home of Poultry. Our chickens have probably come from the wild jungle fowl of India. Early man used to snare and kill these large wild birds for food and rob their nests, because he liked the eggs to eat. When men settled down and gave up their wandering life, they tamed and fed the jungle fowl. In time their wings grew smaller, because they used them so much less, and their bodies grew heavier. So to-day we have the contented hens that stay quietly in their pens and cackle to let us know when they have an egg ready.

Value of Fowls to the Farmer. Since the farmer has learned in the last few years to take better care of his poultry, it is now thought that they pay better for what they eat than any other stock on the farm. There is a great demand for "broilers" from ten to twelve weeks old, and they bring fancy prices. The number of eggs used in the United States daily is beyond our imagination. It is estimated at about forty-four millions. Besides supplying eggs and meat for the farmer's use, the chickens, if they are allowed to roam, catch many grasshoppers and insects. During the summer months they get most of their food on the range. They like grass, seeds, bugs, lime, and grit.

Four Classes. Chickens have been divided into four classes. The large, fat, meat-producing kind does not lay well. They are the Cochins and Brahmas (Fig. 30). The Leghorns and Minorcas are especially valuable for producing eggs. They are a small, wiry sort with large combs. They lay large, white eggs and seldom want to hatch them, so they can be kept laying for long periods. Their flesh is not so excellent for the table as other breeds, but they are very popular among poultry keepers near large cities where fancy prices are paid for eggs. The fancy or game chickens are beautifully feathered birds and are kept for show. To this class belongs the bantam that is too small for real use.

The General-purpose Fowls. But the best chickens for farmers to keep are the general-purpose

Fig. 30. *Light Brahmas.*

fowls that have nice, tender meat. They both lay well and make good mothers. To this class belong the different kinds of Plymouth Rocks (Fig. 31), Wyandottes (Fig. 32), and Rhode Island Reds. These breeds were all developed in America.

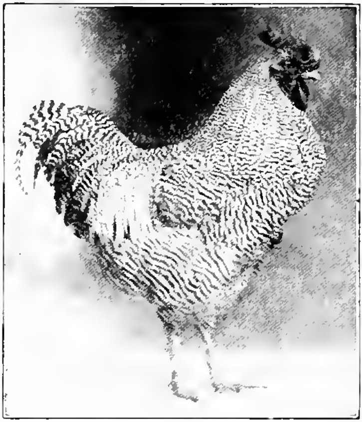


FIG. 31 *Barred Rock.*

Habits. Chickens swallow their food whole. It is softened in the crop and ground into particles in the stomach, or gizzard, which contains gravel or grit. Fowls tip their heads back to swallow when they take a beak full of water, because they have no muscle in their throats. Chickens wallow or take a dust bath to drive away insects or clean their skins; and in wet weather they oil their feathers so they will shed water well and so keep their skin dry.

The Nests. A hen will hide her eggs, if possible, so a cozy place should be arranged in a quiet, dark place for her nest. She begins to lay in the spring, one egg each day. If left to herself, she would commence to sit as soon as she had twelve or fifteen eggs. By removing the eggs she is kept laying a much longer time. The breeds that do not sit

Fig. 32. *A pen of White Wyandottes.*

have been known to lay as many as two hundred thirty eggs in a year.

Poultry in Pens. Chickens that have free range are more profitable and do better than those kept in pens. But fowls can be kept under many conditions. To do well they must have reasonably warm, dry quarters with plenty of light and fresh air. In parts of the West, where it is dry, a frame of poles is set up in November and covered with straw. The chickens run inside this warm shelter and do well. If a hen is protected from draughts, frost, lice, and bad air she is likely to think spring has come in February and will begin early laying, or perhaps she will lay all winter. Some breeds lay well in the winter time when they have good care.

Care of Henhouse. Farmers should clean up their old henhouses with a shovel, broom, and boiling water. They should paint the roosts with kerosene to kill lice, and whitewash the walls. The cracks can be stuffed with straw and covered with tarred paper. Very soon the farmer will see his hens doing better. Leaves or straw make a fine floor covering, and they force the fowls to scratch for the grain. The house should be kept clean and fresh leaves or straw put in each week. (Fig. 33.)

Laying Hens. Laying hens require different food from those intended for table use. Variety of food is important. One reason the hen lays in summer is because she chooses her own food and has a balanced ration. She eats all day long, a little at a

time, and does not mope. A moping hen does not lay well, as exercise is necessary. Chickens in a pen need animal food, such as meat scraps and skimmed milk, to take the place of the insects that they get when they are allowed to roam. Cracked oyster shell furnishes lime for making the eggshell, and grit must be provided for grinding their food. Fresh water in clean dishes should always be within reach. During the winter season, corn may be given once a day because it is a warming food. Ground bone, table scraps, cooked potatoes, turnips, and vegetable tops are given instead of green food. Eggs, like milk, often show by their color, flavor, and odor what food the hens eat.

Hatching Little Chicks. Hen's eggs are hatched by keeping them at the same warm temperature for twenty-one days. Many farmers prefer the hen to incubators for hatching. Perfect-shaped eggs with good firm shells should be selected for hatching. The fresher they are the better. When two broods of chicks are hatched at the same time, one hen may be able to mother both.

How to Care for the Brood. Little chickens must be kept dry and must be carefully fed three times a day. Corn meal and bread crumbs and the yolk of hard-boiled eggs are a good beginning. If chicks are in a pen, cut grass from the lawn makes good green food. Soon a little chicken will eat wheat and cracked corn. Chicken lice are a great trouble to the tiny chicks and the mother hen, and the nest

FIG. 33. *A sanitary poultry house.*

should be dusted with powder a week before the chickens are hatched. Some of the powder may be mixed with lard and rubbed well on each chicken's head.

Brooder Chicks. Incubator chickens have no mother to teach them to eat grit and green stuff.

When chicks are first brought to the brooder, bread crumbs are sprinkled upon the floor among the grit, and in this way they learn to take food and grit at the same time. To make them eat promptly, the

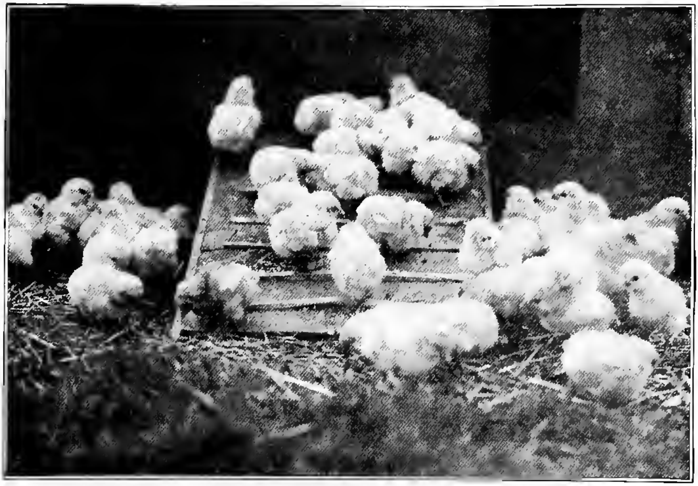


Fig. 34. *Incubator babies.*

food may be taken away after five minutes. (Fig. 34.)

Fattening Broilers. When the chickens are weaned from the hen, the cockerels are put in a yard by themselves and fed on porridge made of four parts of corn meal, two parts of middlings, and one part beef scrap. The mixture is wet with skimmed milk until it will run from a wooden spoon. They are fed this at morning and at evening. They are allowed plenty of shade and kept as quiet as

possible. This makes them more meaty and soft than those that exercise. Chickens about a hundred days old gain the most rapidly. They often gain from one and three-fourths to two and one-fourth pounds in a month. When cockerels weigh two pounds or over they should be sold for broilers.

Poultry Pests. Hawks capture many chicks. A good marksman can kill a few and hang them on poles around the yard as an object lesson. The best remedy is to keep the chicks in yards covered with wire until they are large enough to run for shelter. It is well to have low-growing shrubs where chickens can hide. If pigs run in the same field with chickens they must be watched, for if a pig once gets a taste of chicken, he will chase them continually. Rats trouble chicks at night. Cement floors and stone foundations in chicken houses will keep out rats. Poison may be used if it can be kept away from the chickens.

CHAPTER VII

TURKEYS, DUCKS, AND GEESE

Turkeys. A flock of turkeys has helped many a farmer's daughter to a new winter outfit or bought her things to go away to school. Besides being a profitable bird at Thanksgiving time, they destroy millions of bugs which would injure the crops. The bronze turkey (Fig. 35) is the most common in the United States. Some turkeys are hatched by hens and some by incubators. The first food should be the curd of milk made like cottage cheese. To the cheese should be added chopped boiled eggs and a bread made of corn meal, skimmed milk, and salt. After turkeys are six weeks old, they get their own living catching grasshoppers and bugs. They need clean pens and clean food. Dampness is sure to kill young turkeys, so they should be kept in their pens in the morning until the dew is off the grass.

FIG. 35. *Bronze turkey.*

Fattening Turkeys. The turkey is usually allowed to roam until he is ready for market,

but about the first of October he should have an evening meal of good yellow corn. It is well to begin with a little at a time, but by the first of November he must go to bed with a full crop every night. This makes the flesh yellow, juicy, and tender.

Ducks. Pekins are the most popular ducks (Fig. 36). Duck's eggs can be hatched under hens or in incubators. The first food of the ducklings should be a moist mash instead of dry feed. Ducks need plenty of water to drink, for they take a mouthful of food and wash it down with water. They must have drinking pans deep enough so they can stick their heads in over their eyes, because that is their way of keeping their nostrils and eyes clean. The birds are dry-picked to save the feathers for pillows. Duck's eggs are popular, especially at Easter.

FIG. 36. *Pekin ducks.*

Geese. The goose is the Christmas bird (Fig. 37). When geese are allowed to roam they gather most of their food, which is usually grasses and insects. In the winter months they must be fed one meal a day. Geese graze as freely as cattle and have been accused of destroying the roots of grass. They must

have plenty of water for the same reason that ducks need it. The eggs are best hatched under a hen. A sitting goose is very cross and has been known to break a man's arm with a blow of her wings.

Young goslings are easily chilled and must be looked after during cold rains. To make a rapid

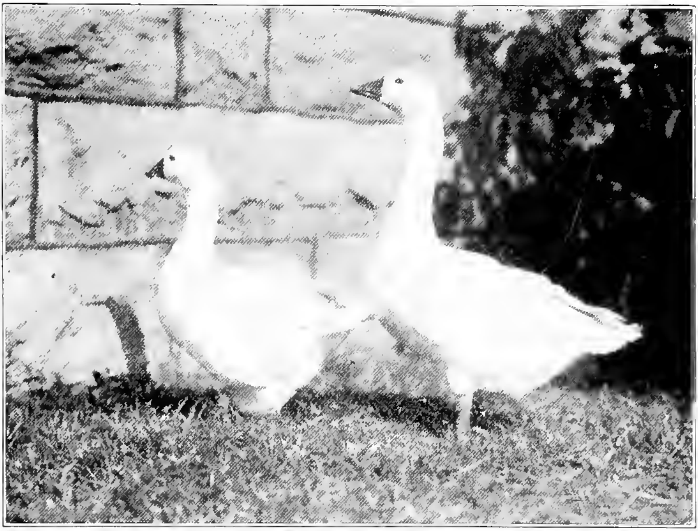


FIG. 37. *The Christmas bird.*

growth, geese must be fed wheat bran, corn meal, and scraps. They should have plenty of shade, water, and grass. They may be made ready for market in three months. Their feathers are valuable for pillows and many other things.

CHAPTER VIII

INSECTS

Insect Enemies. Almost every plant has an insect enemy that feeds upon it; and the farmer who wishes to protect his crops, orchards, and gardens must know how to fight these plant enemies. Insects form about nine-tenths of all the animal life upon the earth. Hundreds of millions of dollars' worth of farmers' produce is lost each year because of insects. (Figs. 38, 39, 40, 41, and 77.)

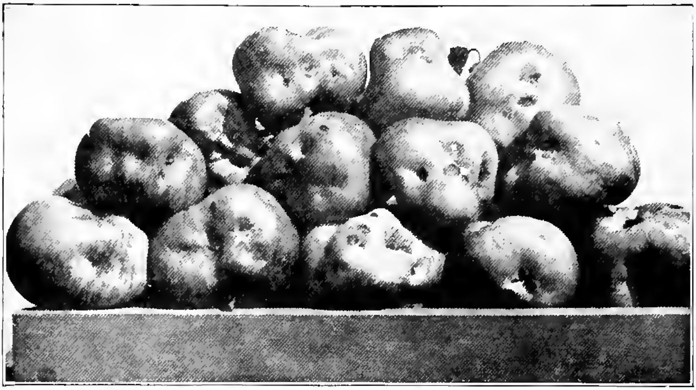
Insect Friends. Certain insects, however, are useful to mankind. Some gather honey and carry pollen from flower to flower, while others spin silk, and still others clean away dead animals. These friends of man are: bees (Fig. 45), wasps, dragon flies, tiger beetles, silkworms, and many others.

Parts of Insects. Insects when full-grown have the body divided into three parts: the head, the middle part, or thorax, and the abdomen or back part. On the head are the eyes, the feelers, called *antennæ,* and the mouth. The chest or thorax bears the wings, of which there are usually two pairs, and six legs.

Biting Insects. There are among insects two kinds of mouths. Such insects as grasshoppers and beetles bite the food. Others, such as mosquitoes, bedbugs, bees, and butterflies, suck their food.

Insects with biting mouths have two pairs of jaws with which they chew their food; and they often eat bark, leaves, fruit, and flowers. All these biting insects may be killed by spraying poison on the plants on which they feed.

Sucking Insects. Insects with sucking mouths usually live upon the sap of plants or the blood of



Courtesy U S. Dept. of Agriculture

FIG. 38. *Knotty apples from trees that were not sprayed.*

animals. Some few of them, such as bees and butterflies, feed largely upon the nectar or sweets of flowers. Since they get their food from the inside of the objects on which they feed, we can not poison them, but must find some other method of fighting them.

Contact Insecticides. Substances have been discovered which will kill insects when covering or touching their bodies. These are called contact

insecticides. Insects do not breathe through their noses or mouths, but they have little holes, or pores placed along both sides of their bodies, and through these the air passes in and out. When anything clogs these breathing pores, they die. It has been found that certain oils and powders will destroy insects by smothering them. Oils may be mixed with

Courtesy U. S. Dept. of Agriculture

FIG. 39. *Apples from trees that were sprayed. No farmer can afford to neglect his fruit crop.*

other materials so as to prevent damage to the plants on which the insects live. Kerosene emulsion is such an insect destroyer. Poisons may be put on the plants before insects appear as a protection, but contact insecticides must be applied to the insects themselves.

Moulting of Insects. Insects have no bones or inside skeleton, but the skin becomes very hard and

horn-like and is usually considered the skeleton of the insect. As it becomes hard it will not stretch; and when the insect has grown so large as to entirely fill this hard coat, a new or soft coat forms underneath; and the old one is shed or cast off. The casting off of an old coat, or shell, is called moulting. The skin is moulted several times during the life of the insect, and each time it becomes larger. The chief changes in the insect's life usually come in the last two moults.

Courtesy U. S. Dept. of Agriculture

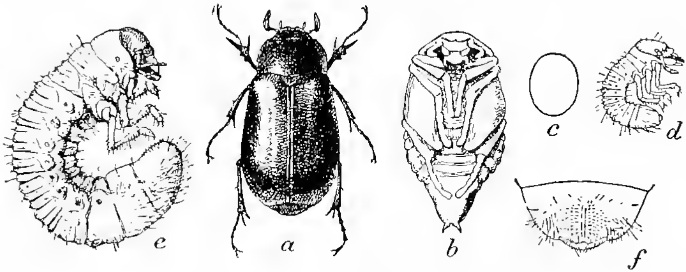
FIG. 40. *Curculio depositing its egg upon a young peach.*

Stages of Development. Wasps, bees, butterflies, moths, beetles, flies, and mosquitoes have very remarkable changes in the last moults. Such insects are said to have four stages of life: (1) the egg stage, (2) the larva or grub stage, (3) the pupa stage, (4) the adult stage. (Figs. 42 and 43.)

Courtesy U. S. Dept. of Agriculture

FIG. 41. *The young grub destroying the fruit.*

Larva Stage. Eggs hatch into the larva stage, which is the time of growth and when most of the eating is done. The larva of a butterfly is a caterpillar, that of a fly is a maggot, and the larva of a mosquito is a wiggler. Some insects eat all the time during this growing stage, never going to sleep.

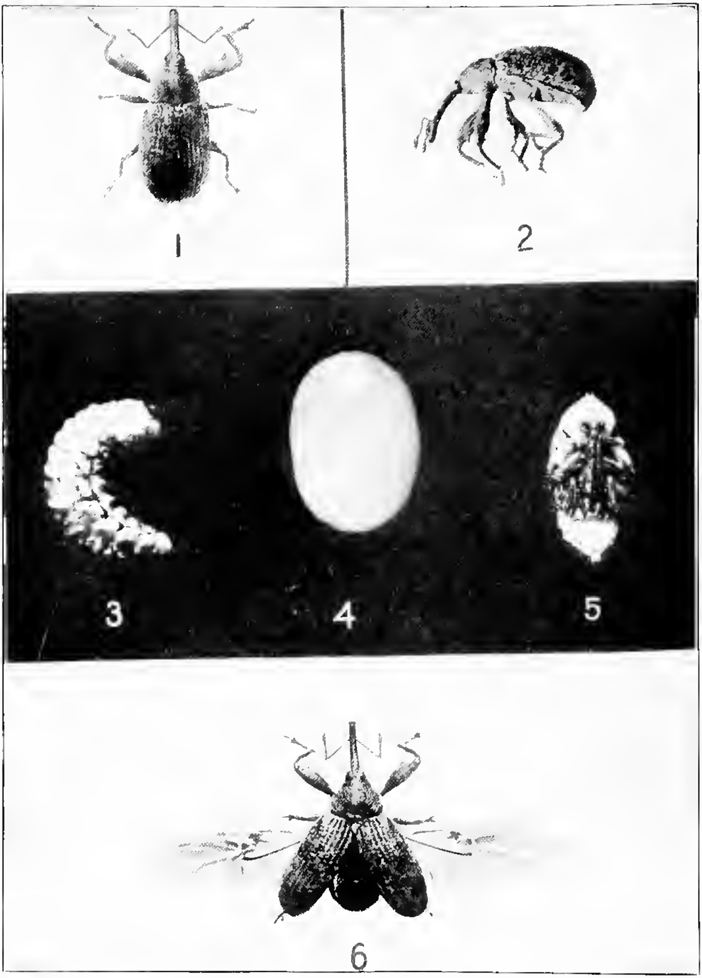


Courtesy U. S. Dept. of Agriculture

FIG. 42. *May beetle, called also June beetle or June bug; a, beetle; b, pupa; c, egg; d, newly-hatched larva; e, mature larva; f, anal segment of same from below.*

They stop only long enough to cast their coats. The kinds that live on flesh have, in some instances, been known to eat two hundred times their own weight in a single day.

Pupa Stage. The larva then goes into a resting or sleeping state, enclosing itself in a case of some kind. This is called the pupa stage. Silkworms spin for their pupa stage a silken covering called a *cocoon.* While in this state the insects go through many wonderful changes. Wings and legs are grown and after a short time the full grown or adult



Courtesy U. S. Dept. of Agriculture

FIG. 43. *Mexican Cotton Boll Weevil. 1, Weevil, back view; 2, weevil, side view; 3, fully-grown larva; 4, egg; 5, pupa ready to transform; 6, adult weevil with wing covers raised and wings extended, ready to take flight.*

insect comes forth a fly, a mosquito, or a beetle.

Freezing the Insect. The blood of insects is transparent like water and is pushed along through the body by the beating of a large vein or artery which lies along the back, instead of by the beating of a heart. Insects are cold-blooded and can freeze without being killed. During the winter insects hibernate; that is, a great many varieties live through the winter hidden away among old grass or under stones, logs, bark, and in the ground. Even the eggs of insects may be frozen solid and remain uninjured.

Insect Life Short. Insects generally die soon after laying their eggs, though some kinds live longer, raising several broods. A great many die before their eggs hatch. Insects are found in all countries at all times of the year. They are found in our homes, gardens, and fields; in the air, water, and the earth: both within and upon the bodies of animals. We shall learn more of the different kinds of insects as we study the chapters on crops.

CHAPTER IX

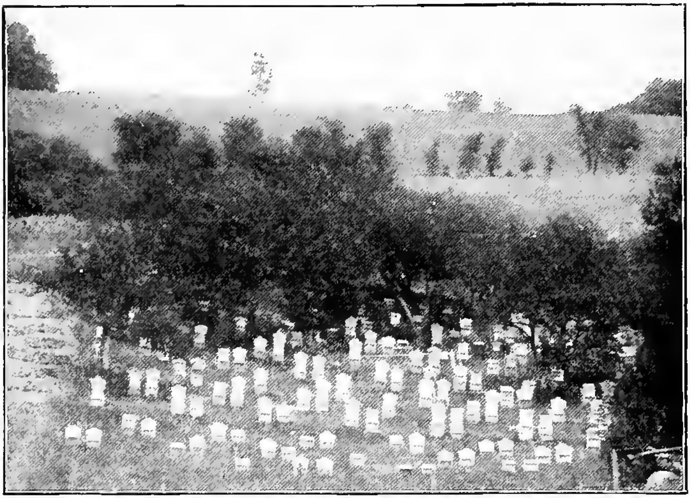
THE BEE

The First Sugar Makers. All the old Bible countries had their beekeepers. Before the growing of sugar cane and the making of sugar was begun, bees furnished the only means of sweetening food. Our savage forefathers probably robbed the hollow trees where bees stored their honey and in time learned how to capture swarms. In England, not many hundred years ago, swarms of bees were so prized that they were willed from one family to another.

Finding the Bee-Tree. To find a "bee-tree," the hunters took to the edge of the woods boxes of diluted honey; then they followed in the direction the bees took as they flew home. It was believed when the bee had his honey basket filled, he took the straightest way possible to the bee tree. That is how we came to have the expression, "Take a bee line."

The Honey Train. An American invented the hive which makes it possible for one man to take charge of many bees. There are many men who make beekeeping their business (Fig. 44). It has been estimated that if all the honey manufactured in the United States in one year were put in cars, it would make a train thirty-five miles long.

Where the Honey Comes From. Bees, with their long tongues, take the sweet juice, or nectar, from



Courtesy of "Bee Culture," Medina, Ohio

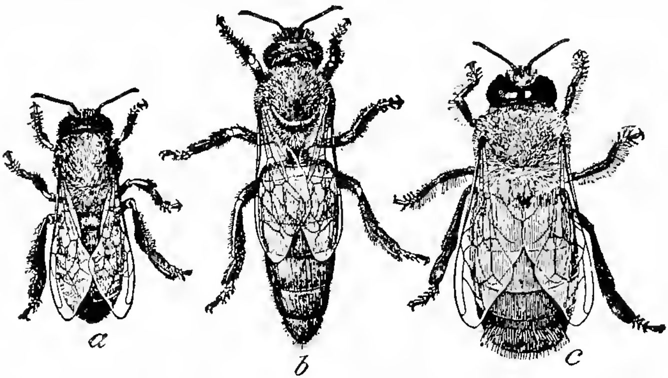
FIG. 44. *A profitable apiary.*

flowers, clover, buckwheat, alfalfa, black gum, chestnut, and catnip. This nectar we may taste by pulling a clover blossom to pieces, but only the bee knows how to make it into honey.

Pollen and Wax. It was once thought that the bees used the little yellow balls, which we sometimes see clinging to their hind legs, for making wax; but now we know the little yellow balls are made of pollen which the bee gathers from flowers for the purpose of feeding its young, and that the wax is secreted from their own bodies in much the

same way as a cow secretes milk. The wax forms in little scales on the under side of their bodies, and when they want to use it they pick it off with their feet. After mixing it in their mouths, they use it in building the beautiful combs with the six-sided pockets in which they store honey.

Members of the Bee Family. We do not care to



Courtesy of U. S. Dept. of Agriculture

FIG. 45. *The honey bee; a, worker; b, queen; c, drone.* [*Twice the natural size.*]

go very near bees when they are at work, so not many of us know the difference between the queen, the workers, and the drones (Fig. 45). The queen is the largest and the most important bee in the hive. If we examine the cell, or living room of the queen bee, we shall find it nearly four times as large as those of the other bees. It is about the size and shape of a peanut and is usually placed on the edge of the comb.

The Work of the Queen. The queen is the mother bee, and she lays all the eggs. It is said that a queen bee has laid more than three thousand eggs in a single day. There are some seasons when she does not lay so many, and there are other seasons when she does not lay at all; but it does not take long for her family to become too large for the hive.

Why Bees Swarm. When the family becomes too big, they form a new family, or, in other words, they "swarm." (Fig. 46.) A cloud of bees comes out of the hive and lights on a near-by bush. From

Courtesy of "Bee Culture," Medina, Ohio

FIG. 46. *A stand of bees near the swarming time.*

here they send out scouts to find new housekeeping quarters; they also wish to make sure their queen is with them. If they find she is not with them, they return to the old hive and wait for her before they start again. If the beekeeper is watching, he makes ready a clean, fresh hive and either shakes them in or places it where they will go in.

The New Queen. The queen which takes her place in the old hive comes from an egg laid in the queen's cell. She has been fed with "royal jelly." This is much richer food than that which is fed to the baby bees which grow into the workers or drones, and it makes a much larger bee. (Fig. 45-b.)

Getting a New Queen. In case an accident happens to their old queen, the bees have a curious way of getting a new one very soon. The drones choose three cells which contain newly-hatched bees, they knock out the partition cells, kill two of the bee-babes, and feed the third on "royal jelly."

Dividing the Work. There are from thirty thousand to forty thousand workers in a good strong colony, and each bee has its own work to do. The young bees build the comb, feed the newly-hatched bees, and do general housework; those a little older secrete wax and help their elder brothers to shape pockets for storing the honey which these older bees bring in. A queen may live four or five years, but the workers that are hatched in the spring, work so hard that they often wear themselves out in forty or fifty days.

The Drones. The drones are the male bees. They are larger than the workers and have no sting. Somebody has called them the "tramps" of the bee family, because they do no work. When the workers tire of feeding the drones, they kill them and throw them out of the hive. (Fig. 45-c.)

The Kind to Keep. Bees have been known to make from twenty-five to thirty pounds of honey in a year in one hive. The Italian bees are considered the finest, because their longer tongues can reach nectar in the flowers that the black bee can not reach. They are also more gentle and easy to handle.

Helping the Bee. To secure honey in the best shape for the market, the beekeeper places in the top of the hives frames which hold just one pound of honey. (Fig. 47.) These have a sheet of wax on which is impressed a network of six-sided cells. From this foundation, new cells are built by the bees. A machine has been invented that saves the time and energy of the bee in wax making.

The Honey Extractor. Once a beekeeper's little son was playing with a piece of unsealed honeycomb in a basket. The lad had tied a piece of string to the handle. As he whirled the basket around and around in the air, his father noticed the honey dripping from the basket. When he found the cells of the honeycomb were nearly emptied without injuring the comb he thought, "How much labor it would save the bees if they could fill their combs again instead of having to make new ones!" So

Courtesy of "Bee Culture," Medina, Ohio

FIG. 47. *It's all in knowing how.*

he invented the honey extractor which empties many combs at once and gives us the clear strained honey. It removes the honey from the comb without injury to the comb and without destroying its place in the frame; and these old combs are put back in the hive to be filled again. In this way bees are kept busy gathering honey instead of building comb.

Keeping Them Warm in Winter. Bees must be protected from the cold in winter, or they may die. The "box hive" incloses the real hive, leaving a space to be filled with chaff and other packing material. A small opening is left so the bees can get out in cold weather. They must have exercise in the open air to keep well.

Do Not Starve Bees. In removing honey from the hive, care should be taken that there is enough left to feed the bees through the winter season. Sometimes a keeper prefers to feed the bees on a sirup made of sugar, so he can sell all the honey.

Another Service. Besides the income the bees bring the farmer in honey and wax, they do him another great service. They scatter pollen from one plant to another. Many plants cannot bear fruit or seed unless their pollen is mixed. The wind does some of this, but the bee is the best mixer. He dives into the heart of a flower for nectar and gets his body covered with pollen and takes it with him to the next plant. It is said clover would not grow on the island of New Zealand till bumblebees were taken there to scatter the pollen.

Busy as a Bee. Now we know what busy, strange, helpful little creatures the bees are, and we do not wonder at the old saying, "As busy as a bee." Every farm has enough plants to provide several swarms with pollen and nectar, so that each one may have its own honey. What one needs to know about beekeeping he may learn largely from books, because it is said that more books have been written about the bee than about any other domestic animal.

CHAPTER X

BIRDS

A Story. A certain beautiful poem tells this story. Once upon a time the farmers of Killingworth were troubled and angry, because the birds ate so much of their fruit and grain. So they held a town meeting and ordered every bird killed. Only one man, the village teacher, pleaded for the birds. He said it would be lonely without their cheerful songs. He reminded the farmers of the many insects which the birds devoured. He told them that the few cherries and the small measure of grain the birds ate were only just wages for the hard work they did in protecting the farmers' crops from worms and bugs. But the farmers did not heed his warning. The parent birds were shot and the little ones starved in their nests. For one long summer

FIG. 48. *The Red-headed Woodpecker, an enemy of tree insects and a friend of the farmer.*

there were no birds in Killingworth. Hundreds of caterpillars and cankerworms and small insects destroyed the crops and the leaves on the trees. The land looked like a desert. At last the foolish farmers saw their mistake. They hastened to send away for many cages of singing birds which were again allowed to fly about at will. The story ends here, but we are glad to know that the birds we all love so much are of great use to us.

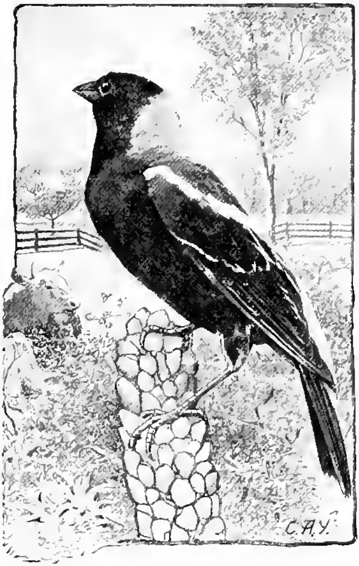


FIG. 49. *The Bobolink, an enemy of grasshoppers, caterpillars, army worms and the like.*

Service to the Farmers. It will be impossible to mention here all the helpful birds. Robins hop about the fields and lawns and gardens, destroying grasshoppers and earthworms. The bluebirds, warblers, and chickadees work among the tree-tops, catching the insects which eat the tender leaves. The nuthatches, creepers, and woodpeckers (Fig. 48) patrol the bark of the trees, finding plant lice and borers.

Other Friends of the Farmer. The swallows, flycatchers, and kingbirds sail about the air, snapping

up flies and mosquitoes. When darkness comes, the owls and nighthawks go on duty and capture insects of many kinds. They swoop down and catch moles, meadow mice, and rats, that do harm to farmers' crops.

Grosbeaks Are Friends. Grosbeaks are of such particular service to the farmer that in many states they are protected by law. The rose-breasted grosbeak, or "potato-bug" bird makes a tenth of his diet of potato beetles (Fig. 77). He also eats the cucumber beetle. He is accused of eating peas, but he is so useful in the garden that it is worth one's trouble to put netting over the peas. He may also be kept away by a scarecrow. He is very fond of orchards, for cankerworms, caterpillars, and the moths and scale insects that attack trees are his special delight at meal time. The cardinal, or red-bird, belongs to the grosbeak family. They have been accused of pulling sprouting

FIG. 50. *The Meadow Lark.*

grain, though the examination of the stomachs of five hundred cardinals did not prove this to be true.

Tarring the Seed. To prevent the western grosbeaks from pulling the seed grain, the farmers soak the seed corn or other grain in a barrel of water and stir it thoroughly with a stick dipped in gas-tar. When the grain becomes black, it is spread on sacks and dried in the sun. With this coating of tar, it is safe from the birds. Seed planted with a checkrow planter is not disturbed because the earth is packed.

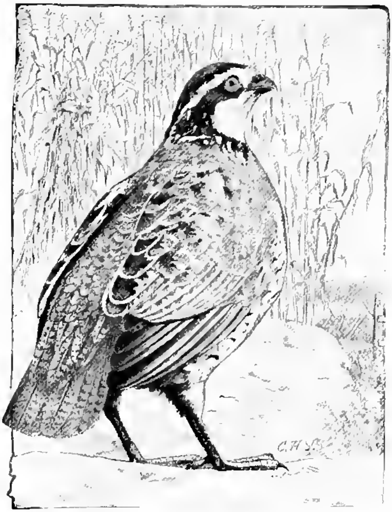


Fig. 51. *The common Quail or Bobwhite.*

Protecting Grain Fields. Some farmers protect their fields of ripe grain by planting a few rows of millet on the edge of the field. Birds prefer millet to other grain, but it should be sowed so as to ripen at the same time as other grain.

The Grosbeak and the Orchard. Mulberry and june-berry trees will protect an orchard in the same way. The black-headed grosbeak, if not prevented, eats a good deal of fruit; but it has been estimated

that for every quart of fruit he eats, he consumes, by measure, a quart and a half of black olive scales, a quart of flower beetles, and a large quantity of codling moth babies and cankerworms. If this is true, he certainly saves much more fruit than he destroys.

Policemen of the Air. Some one has called the birds the little policemen of the air, because they protect us from the robber bugs and caterpillars. Insects make up nine-tenths of the animal life of the world, and it has been estimated that a bird will destroy thirty insects daily, so he is a very valuable little policeman.

Eating Weed Seeds. Another great foe of the farmer is weeds. In one state alone the tree sparrows are reported to have eaten eight hundred seventy-five tons of weed seed in one season. This included smartweed, ragweed, bindweed, crabgrass, and many others. The bobolink and meadow lark destroy many insect enemies of the crops and untold quantities of weed seed. (Figs. 49 and 50.)

FIG. 52. *Making friends of the birds.*

Big Appetites. Birds need a great deal of food, because they are so active. They eat all the

time they are not sleeping or caring for their young. One flicker was found who had in his stomach five thousand ants; a nighthawk ate at one time sixty grasshoppers, and a bobwhite (Fig. 51) ate seventeen hundred seeds of weeds for one meal.

Making Friends of Birds. Birds may be coaxed to stay near the house and garden by protecting them from cats and bird-dogs and by making nesting easy for them. One kind-hearted farmer built a home for a wren. It was a box six inches square and about eight inches high. He put a little perch on the front and an entrance hole only one inch across, so the sparrows could not get in. He did not paint it, but left it wood color, for birds do not like bright-colored dwellings. The same little wren came on the fifth day of May every year for seven years and kept house in it. Martins and bluebirds also settled down in his bird houses. (Fig. 52.) The farmer's wife coaxed the orioles to build their strange little pouch nests on the limbs of their elm trees, by putting out yarn and cotton twine on the bushes in the nesting season. Covered arbors were made and vines allowed to grow to make sheltered places for rearing their young.

Sharing with the Birds. A big mulberry tree in the garden furnished food for many songsters as well as plenty of pies for the farmer's family. On top of posts in the yard, out of the reach of cats, were shallow dishes which provided water for the birds; and the farmer left an opening under the eaves of

his barn so the swallows could get in and keep house among the rafters, because they keep the barn free from gnats and flies. This bird-lover was not so cordial to crows, blue jays, sparrows, and chicken hawks, for they destroy the eggs and the young of the song birds.

PART II. SOILS AND FARM CROPS

CHAPTER XI

SOILS

What the Soils Do. The layer of dirt or crust that covers the earth is called the soil. It is so thin in places that the rocks appear through it. In other places it is deep. Plants and insects, birds, beasts, and men, are all fed on what grows in this layer of soil. It is marvelous that soil will produce so many different kinds of plants.

A Light Soil. As we go about we notice that the soil of some fields looks quite different from that of others. Here we find a loose soil in which we can easily see a large amount of common sand. There we find soil that contains so much clay that bricks can be made of it. The more sand a soil contains the easier it is to cultivate it. It works better under the plow and harrow. For this reason a sandy soil is said to be a light soil.

Heavy Soil. Clay soils stick together and are hard to work, both when they are very wet and very dry. If we make clay into mud pies, they will crack when they are dry. Clay soils behave this way in the fields. We have all seen the big cracks in clay soil in the dry midsummer. This kind of soil is said

to be cold, because it holds so much water instead of allowing it to pass through easily. Because clay soils are sticky and hard to work, we call them heavy.

Crops for Clay Soils. Clay soils are excellent for pastures, and they wear well. Apples, pears, and grapes do well on them. They also produce good crops of hay, wheat, oats, beets, cabbages, and turnips. But clay soils are too cold and wet for corn and too hard to allow potatoes to grow freely.

Loam. A soil that is composed partly of clay and partly of sand is called loam. If there is more clay than sand, it is called a clay loam; if there is more sand, it is a sandy loam. A true loam is made up of about equal parts of clay and sand. This is the best farm soil, for loam makes a good home for plant roots. It is easy to cultivate, and because it allows moisture to pass through it readily, no time is lost after rains in waiting for it to dry out.

What the Soil Contains. We know that all soil is made up of fine particles of rock or sand, of decayed plants, of water, and of insect life. It also contains air and another plant life which, perhaps, we do not know about, because we cannot see it. They are so small it would take many thousands of them to measure an inch. This low, tiny plant life we call bacteria. They are very useful in changing the soil so as to make it ready for plant food. Bacteria must have air to live, and that is one reason we must have air in the soil.

Plant Food. In order that plants may grow, they need certain foods that we call plant foods. Plants get this food from the soil and the air. In order not to rob the soil, we must know what our crops are taking out of it and how to put these plant foods back.

Plants Need Many Foods. The plant needs a variety of foods, just as a hungry boy does. Ordinary plants need about thirteen different kinds. Some of these elements, or different kinds of foods, are obtained from the air, and others from the soil. To grow good crops, the soil must not only have enough of all the foods that the plants need, but they must be in such form that the roots can take them up and use them to build up the stalk, leaves, and fruit.

Only Liquid Food. The foods taken from the soil are called mineral foods, because they are actually bits of minerals dissolved in water just as you dissolve sugar or salt. Plants drink their food through tiny, hollow root hairs that take up this water solution. They cannot take up solid particles of soil. So all this mineral plant food must be dissolved in water before it can pass into the plant and become a part of it.

Water the Chief Plant Food. When soil is perfectly dry, plants cannot grow in it, for water generally forms about three-fourths of a plant's weight. Since the plant can take plant food from the soil only in liquid form, we see that water itself

is not only an important plant food, but it carries to the stalk and leaves nearly all the other foods they need. After traveling through the rootlets up the stem to the leaves, the water that is not needed passes off from the leaves into the air. Therefore we see that plants take in much more water than they can use, for the sake of the food that the water brings with it. We are told that timothy hay needs three hundred tons of water to obtain the other foods necessary to make one ton of hay; oats require five hundred tons of water for a ton of plant.

Other Food. A bundle of wheat as it comes from the self-binder weighs about ten pounds, and nearly nine and one-half pounds of this is composed of water and the carbonic acid of the air. A large part of the farmer's labor is done to supply the elements that make up the other half pound of this bundle of wheat. It contains ten simple foods and no two in equal amounts. The wheat cannot spare any one of these ten plant foods. So when the soil loses one element of wheat food, it is no longer good wheat land.

Humus. Different parts of the same fields may have different colors. The red color of some clays is due to the iron in them, but the brown or black color of soils is usually due to the humus that they contain. Humus is the decay of plants. The leaf mould which we find under the dead leaves in the woods is a good sample of humus. This is a very important element in soil. Humus not only makes the

soil dark and rich, but it makes the ground loose and mellow so air can get in. It also enables the soil to hold far more moisture than would be possible without it. Plants, we know, need both air and moisture about their roots, so humus is a valuable aid to the farmer.

Soil and Surface Water. How does the soil obtain and keep moisture and give it over to the plants? If we go into the fields after a heavy rain, we notice muddy streams running from the plowed land, carrying off good, fine soil. Part of the water that falls as rain and snow, runs off instead of sinking into the earth. This we call surface water, and it often does much damage to our fields; but much of the water that falls upon the ground sinks into the soil through cracks and holes and between the tiny grains of soil. When the land is dry the farmer likes a slow, steady rain, because it all soaks into the ground to feed plants, instead of running off as surface water and carrying good soil with it.

Why Clay Soils Are Wet. As the water passes through the soil, each tiny grain of sand and each little particle of earth is covered with a coat of moisture. All through the soil are small holes or open spaces between the grains, and into these the water goes. In such fine soil as clay, which packs closely, the spaces are small, and the water cannot pass through rapidly; so it is kept back in holes, open spaces, or puddles. In loose, coarse-grained earth, such as sand, the spaces are large; and the

water passes through rapidly. This explains why clay soil is sticky and wet while sand is a dry soil and almost never forms puddles.

Holding Water for Plants. It is easy to understand how water will move downward through the soil wherever there are openings or pores. We also know that water-coated particles will pass on some of their moisture to dry ones that touch them, just as lamp oil passes up the wick. Thus, you see, moisture is always moving toward dry areas. This means a great deal to plants, for when their rootlets drink up the water that is around them and the soil about them is becoming dry, more moisture moves toward the dry place and supplies the thirsty plants. In this way plants may obtain nearly all the water in a good soil.

Importance of Drainage. Some regions have considerable rainfall. Water soon forms a coat about each tiny grain of soil and fills the pore spaces. If more rain keeps falling, and the water cannot pass down easily through the soil, we have swampy land. This happens especially where the under drainage, as we say, is not good. In such swampy lands, the open spaces, or pores of the soil, are always full of water, and no air can penetrate the soil.

Good Soil Contains Air. All plants need air about their roots as well as about their stems and leaves. The roots can not do their work without air, and they will not go deeper than the air can follow. Without air, seeds will not sprout, but will rot.

Then, as we have said, there are the hosts of soil bacteria whose work it is to change certain plant foods for the plant's use; and these bacteria can not live without air.

How to Drain Swampy Land. Level fields of clay soil are often unfit for crops, because they do not drain well. They are always water-soaked and swampy. Thus the farmer must drain such fields or allow them to lie idle. The best method is to tile-drain them. This is done by digging trenches from thirty to one hundred feet apart, according to the soil. In the bottom of these trenches tiles are laid. These tiles are merely hollow tubes about a foot long, made of clay and burnt hard like brick. They are laid end to end about four feet below the surface of the ground. Care must be taken to see that the tile line slopes gradually to some lower level at the creek or river.

How Draining Helps. The tile drains carry away the excess of water. This allows air to enter the soil, and plant roots will follow as deep as the air and so get more plant food. Bacteria can also find better homes because of the air in the soil.

A Map of the Tile Lines. The tile should not be too small, as small ones get filled up easily. Nothing smaller than three inches in diameter should be used, and in many places only four-inch tile are laid. Tiling a field costs a great deal of money and it should be done right. A map of the field may be kept showing just where every tile line is, so that

if a section again becomes swampy, it will be easier to find any tile that has filled up and failed to do its work.

The Farmer's Bacteria Friends. We have learned of the tiny bacteria plants that live in the soil and help to prepare food for the plants we cultivate. Some kinds of bacteria live in other places, and others are harmful; but these soil bacteria are very necessary and helpful, and the farmer works hard to make the soil right for them to grow. There are millions of bacteria in a cubic inch of fertile soil. They do not need sunlight as do most plants, but they do require air, moisture, warmth, and food.

How They Help. Bacteria pounce upon all vegetable matter, such as leaves, wood, grass, and dead animal matter, that falls upon the ground and begins to decay, or rot. The bacteria break up all these substances into simple foods that are ready for the plant to drink. It would be of no use to manure soil if it were not for bacteria.

Bacteria and Clover. Some kinds of bacteria set up housekeeping upon the tiny rootlets of certain plants such as clover, alfalfa, soy beans, and cowpeas. They take a certain element, that we call nitrogen, from the air and store it up in little bunches or swellings on the roots of these plants, ready for them to feed upon. Plants must have this nitrogen as food, and soil that contains abundance of it is rich soil. Every farmer boy knows that the fields are richest where clover, alfalfa, or

cowpeas have been growing. (Fig. 53.) The reason is that the millions of bacteria have been at work upon their roots, storing up nitrogen for them and for other plants to feed upon. This explains why farmers use these crops to build up worn-out soils.

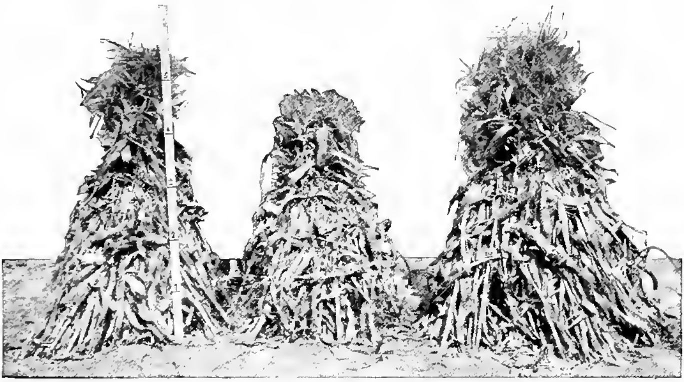
Growing Several Crops. The farmer always raises some crops that pay better than others. Corn may pay better than oats, and yet it is wise to grow some oats, because the two crops can be worked at different times. A farmer may raise all the corn he has time to take care of and still raise a field of oats besides. Barley, oats, and spring wheat require attention at the same time. So the farmer usually chooses only one of these crops. Rye and winter wheat must be worked at the same time, and so the farmer grows but one of these in a season.

Not Too Many Crops. It is better to raise a number of crops than to put the whole farm into one, because the farmer wishes to provide work for himself and his laborers all the time. It is not well, however, to have too many crops, because they may call for too much machinery. A farmer can not afford to buy the necessary tools for potatoes or wheat or orchards unless he has a fair-sized field in such crops. But small vegetables and fruit for home use should all be raised on every farm in gardens and small orchards.

Rotation of Crops. Rotation means that the crops grown on each field are changed every year or two. Nearly every successful farmer does this. Still

there are fields that have never grown any crop but cotton; others, nothing but wheat. This is bad for the land, and the thoughtful farmer does not practice it.

Good Reasons for Rotation. By rotating and having several different crops, the laborers and teams are kept busy. The farmer has some crops



Courtesy of Agricultural Experiment Station, Wisconsin

FIG. 53. *Clover sod with potash and phosphorus fertilizer yielded 26 bushels of corn per acre, shown at the left, as compared with 13.5 bushels where potash and phosphorus were used without clover, shown in the center, and 28.5 bushels where peat, potash, and phosphorus were used, shown on the right. This shows the importance of adding nitrogen and organic matter to sandy soils.*

to sell and some to feed. He also escapes a total crop failure, and he keeps his soil in better condition. By growing the same crops on the same fields year after year, certain weeds get the upper hand. By changing crops, these weeds are checked, because the crops are worked at different times and in different ways. Then, too, there are some plant

diseases and insects that will get a big start unless other crops are introduced on the field. When insects find their favorite crop gone and one growing that they do not like, they are without food and starve to death. But perhaps the most important reason for rotation is to keep up the supply of humus in the soil by growing clover, alfalfa, or cowpeas and plowing them under to restore the vegetable mould or humus.

Rotating in the North. There are different systems or methods of rotating crops. Many good farmers in the Northern states divide their farms into five fields, and on each field they raise corn, followed by oats, then by wheat, then clover, and lastly by timothy. Then they plow the timothy stubble and again start with corn. Try to make five diagrams or maps to show what each field contains each of the five years.

In Potato States. In some potato-raising sections, they have a three-year rotation: a crop of potatoes is followed by one of wheat or oats, and that by a clover crop. Such a farm is divided into three fields. In the Corn Belt a good rotation is corn for two years, next oats, and then clover and timothy.

Rotation for Cotton. For cotton plantations a good system is: Cotton the first year, followed the second year by corn with cowpeas planted between the rows or sown broadcast just before the last cultivation of the corn; the third year oats are grown, and they are followed by cowpeas the same season.

Phosphorus a Plant Food. We have learned that a plant needs many plant foods, but the most of them are usually found in the soil and in the air and water in great plenty. If the farmer needs to put nitrogen in his soil, he may do it best by sowing a crop of red clover, alfalfa, or cowpeas. But all plant foods can not be put back into the soil by a crop. If a farmer raises and sells corn or wheat, he is taking out of his soil and shipping away one important plant food called phosphorus. Most of the phosphorus that corn and other grains require before they can grow well, they store up in their seed or grain. And when this grain is sent away to market, it takes with it three-fourths of the phosphorus used by the crop.

Putting Phosphorus Back. This must be put back into the soil somehow; and it may be done by purchasing bone meal from stockyards companies who buy and slaughter our stock, or by purchasing manure for our fields or by buying rock phosphate from the places in Tennessee or Florida where this mineral is mined and ground for fertilizer.

Keeping Up the Land. Phosphorus is the plant food most likely to be wanting in our rolling prairies, in the hilly timber lands, and in soils worn out by long cultivation. If clover will not grow well, one may feel pretty sure his fields need phosphorus, and, perhaps, lime. For most farms, all that is needed to keep them up is plenty of rock phosphate, with a crop of clover, alfalfa, or cowpeas, in rotation and all the manure made on the farm.

CHAPTER XII

PLANTS AND HOW THEY GROW

Learning about Plants. Since men and animals live largely on plants, and farmers are kept busy growing crops to feed the world, we want to know more about how plants grow and produce seed. We may easily see what the animals about us eat and drink, but it is not so easy to learn just how plants eat and grow and bear fruit.

Dividing Their Work. Plants need food, water, and air, just as animals do. They also need warmth and light. The plant has different parts—a stem, roots, leaves, and flowers. It divides its work up among these parts. The roots of the plants have their work, and it is different from that of the stem and leaves.

Roots and Their Work. Let us first look at the roots. Pull up a radish from the garden, and you notice that the upper part of the root is large and round and is stored full of food. Below is a tap root which grows smaller and smaller to the end several inches down. All along this tap root are tiny rootlets with root hairs branching off from them. These root hairs cover only the tips of the smallest rootlets, but they extend out in all directions. They are very close together, for often there are as many as thirty thousand on one square inch.

They are not young roots, because they never grow larger. They are only tiny little hollow tubes which contain sap. They have no pores, or holes for water to enter, but it easily soaks through their thin walls. Thus these root hairs drink in the soil water which contains many of the plant foods; and the sap carries this watery food up along the larger roots and stem to the leaves. Here the sunshine helps to make the plant food ready to build up the stem, leaves, and the fruit of the plant. The larger roots do not take plant food from the soil. Their work is to hold the plant firmly in its place in spite of storms and heavy rains. When a plant is taken up to be transplanted, most of the small rootlets with their many long hairs are broken off. Perhaps you can now understand why a plant is so likely to wilt when it is transplanted.

The Stem. The stem, or trunk, bears the leaves and holds them up in the air and sunshine. It carries the watery plant foods from the roots up through the outer wood layer to the leaves. The materials, or starch and sugar from the leaves, pass down through the bark to the part where they are needed to enlarge the plant.

The Leaves. But more interesting than roots or stem are the leaves. They serve as so many stomachs where the plant food is digested and made ready for use. The chief work of the leaves is to make the plant foods over into starch and sugar. They take a large part of this starch and sugar,

called carbon, from the air, but the other parts come to the leaves through the root hairs. The leaves also give off to the air all the water that is not needed by the plants. If the leaves give off more moisture than the roots supply, as they often do on very hot days, the plant wilts in order to prevent further evaporation.

The Flower. The starch and sugar made by the leaves is either stored up for food or used at once to build plant tissue. When enough has been stored, the plant begins to flower. The flower is sometimes beautiful like the apple blossom, but often, as in the wheat or oats, it is not showy.

The Seed. The flower of plants has a very important work to do, because it contains the parts which create the fruit. The fruit contains the seeds from which new plants may be grown. If the flower fails to do its work, there will be no fruit, no seeds, and no new plant, unless a new plant can be started from a slip or cutting of the old plant.

The Father and Mother. The flowers of different plants differ very much, but they usually have two parts. One is the "pistil" or mother part, which contains the ovary or seed food. This seed food will not grow into seed unless it receives some pollen or yellow dust that grows on another part called the "stamen." The seed itself is a tiny baby plant all tucked under a good cover with food enough for it to live on until it can send out rootlets into the ground.

The Corn Flowers. Every plant must have its flowers with their stamens and pistil, but the stamens and pistil are not always together in the same flower. Examine a cornstalk as it grows. The tassel is the stamen, or father flower, with its yellow dust, or pollen; and the ear is the pistil, or mother flower. If the pollen does not fall from the tassel on the silks of the ear to fertilize the ear, there will not be a grain of corn on the cob.

Carrying the Pollen. The corn is only one of many plants that have their male and female flowers separate. Such plants depend partly upon the wind to carry the pollen from the father flower to the pistil where the new seed is to grow. Some plants depend upon insects to carry the pollen for them. So these plants have developed bright colored flowers that the insects can easily see. They also secrete a sweet food, or nectar, to reward the insects for their trouble. They hold out bright red and yellow and blue petals and say to the insects, "Here you can get good honey."

Night Workers. Some plants depend upon insects that fly only at night to carry their pollen. These plants do not have bright flowers, because colors cannot be seen well in the darkness. They have white flowers; and to aid the insects in finding them they have a strong, sweet odor or fragrance that guides their friends. The insects come from far and near for the sweets. They brush against the stamens and get covered with yellow pollen dust.

Away they go to other flowers, leaving some of this pollen on every plant they touch. When they go in deep for the honey, they leave pollen on the pistil just where it is needed.

Pollen from Other Plants. Plants bear the strongest and best fruit and seeds when the pollen has been brought to them from another plant. In a cornfield the ears on one stalk may receive pollen from its own tassel and from a dozen others standing near. Sometimes when a farmer wants corn for seed, he goes about a certain part of his corn lot before the silks come out and cuts off the tassels of all the poor stalks. In this way he allows the ears to receive pollen from only the strongest plants.

Kinds of Plants. There are thousands of different kinds of plants in the world. Perhaps there was a time when the world was young when there were very few plants. But as they spread over the earth they found different kinds of homes. Some seeds were gradually carried into cold regions, and others into hot places; some found wet spots, and others came into deserts. Some found homes on high, rough mountain tops where the storms raged about them, while others fell into low, shady nooks where they were protected.

How They Came to be Different. As the plants were slowly carried into such different kinds of homes, they kept fighting for life and food. Often many plants were struggling for air and sunshine on the same little spot; and only those that proved

good fighters lived. Slowly but surely many of these plants changed to meet their new surroundings and became unlike their early parents and even unlike their close kin. Each one set to work to protect itself and get its own food, and thus it slowly developed new parts, new ways of growing, and new ways of fighting for food. Only the best and strongest plants lived to spread their seed. In this way the world came to be covered with untold multitudes of different kinds of plants.

One Interesting Habit. It is interesting to study about the habits of different plants and how they grow and spread their kind. One of the important things about them that the farmer needs to know is how they scatter their seed, because many weeds grow and fight for life where the farmer does not want them.

Scattering Their Seed. Some plants, like the cocoanut, grow their seed in a hard shell which is waterproof, and in this they float on streams and rivers to new homes. The seeds of the maple and ash trees have wings, and on these they sail away across the fields wherever the wind will carry them. The dandelion seed has a queer little balloon on which the wind carries it to some far-away home. Then we know the burdocks and stick tights that catch in our clothes or fasten themselves on passing animals and hold tight for a long ride, to fall at last and set up housekeeping in a new region. Any boy or girl who will examine the seeds of plants

and do a little thinking will discover many interesting and wonderful secrets about their different habits.

How Man Helps. Man has chosen certain plants that furnish food for him and his flocks, and these he tries to help to good homes where they will grow and bring forth their harvest of grain or fruit. He spreads and sows these plants in several different ways. He sows the seed of the common grains or cereals, and covers them with earth. Sweet potatoes are grown from slips or plants; Irish potatoes, from the "eyes" of the potato; grapevines from cuttings or twigs clipped from the vine. Sugar cane is grown by planting a short piece of the stalk. Many plants do not come true from seed, and man has learned to grow them by grafting or budding. A bud or graft twig is taken from one plant and so carefully put upon another that it will grow as part of the plant. And the strange thing about it is that it will produce its own kind of fruit and not the kind of the plant on which it is grafted. There is no end to the wonderful things man is learning to do with plants.

CHAPTER XIII

TILLAGE AND FARM MACHINERY

Sowing and Reaping in Olden Times. For thousands of years after men learned to plant seed they tilled the soil with a forked stick. Their only object seemed to be to get the seed covered in the ground. In Egypt for long ages seed was scattered broadcast by hand and herds of cattle were driven over the ground to tramp it in. These ancient people reaped their grain with a crooked knife and beat the kernels from the husks and chaff with a stick, or

FIG. 54. *The best and cheapest fertilizer.*

flail. Sometimes they drove their cattle over it on the barn floor to thresh it. Then it was ground into

meal in stone basins with stone pestles. The crooked stick also served to dig the root crops.

Wearing Out the Soil. Men of those times did not know how to cultivate crops. They knew that weeds injured the crops, but they did not know that it was because the weeds took the plant food, water, and air that their grain needed. When the land failed to bring a good harvest, the farmer concluded that the field needed a rest; so he rested it, or, as we say, let it lie fallow for one year. He did not know what we do to-day—that his land only needed a rotation of crops, that is, a different crop planted each year, or that barnyard manure would make it fertile again (Fig. 54).

Jethro Tull. About two hundred years ago there lived in England a landlord named Jethro Tull. He watched his crops closely and soon saw that the fields he worked or tilled the most brought the largest crops. He taught other farmers that tillage was the most important part of farming. He believed that fields would never wear out if they were always cultivated thoroughly. He thought that plants took their food in solid little grains or particles, and the only thing needed was to break up the soil very fine and the plants would eat it as a calf eats bran. We know that Tull was mistaken in thinking that plants take their food in solid form, but he did a great service to his farmer friends and to all the farmers since that time by showing them how important tillage is (Figs. 55a and 55b).

Courtesy U. S. Dept. of Agriculture

FIG. 55a. *A field in poor tilth. Crops in such cloddy soil have a slim chance.*

Courtesy U. S. Dept. of Agriculture

FIG. 55b. *A field in good tilth. The best time to cultivate a crop is before planting it.*

Feeding Plants. We know that plants can use only the plant food that is prepared for them. If it is not in the right form, it makes no difference

how much food is in the soil, the plants will die in the midst of plenty. It is the farmer's task to see that the plant food in his soil is ready for his crops to use, and he tills the soil so that moisture can enter and be kept near the roots. Tillage loosens the soil so air can enter. Tillage also keeps down the weeds that steal the plant food and keep out the sunlight and warmth that the crops need. We can see that a great deal depends upon the farmer's stirring his soil at the right time.

Keeping Moisture in the Soil. The well-tilled soil is broken into very fine grains or particles (Fig. 55). These fine particles will hold much more water than coarse ones, because each tiny grain has its own coat of moisture. This, you remember, is the reason clay soil will hold more moisture than sandy soil. Clay does not drink it in so rapidly, but it holds on to it better.

Moisture passes easily from wet grains of earth to dry ones that touch them, so we see that the looser the soil is the fewer are the particles which touch one another. If they do not touch one another, water cannot pass so easily from wet particles to dry ones and in this way climb to the surface and pass off into the air. The surface soil especially must be loose to keep the moisture from evaporating, or getting back into the air.

The Dust Mulch. The loose layer of surface, which we call dust mulch, acts just like a blanket. Turn over a log or a board in the barn lot in the

spring and you will find the soil under it more damp than the ground not covered. The board has kept the moisture from passing off into the air. When we remember how much moisture crops need, we will see how important the dust mulch is. Every time it rains hard it packs this mulch down, and the farmer should cultivate his crop again, to loosen the top soil.

Dry Farming. Perhaps you have read or heard of dry farming. In many places in our great West there is not enough rainfall in a year to raise a crop. But if all that falls in two years could be kept, it would raise one crop. The farmers have learned that if they keep a dry mulch on the ground and save all the rainfall of one year, they have a pretty good chance to raise a crop the second year. It means that they must cultivate or till the ground for two seasons to get one crop, but that is better than raising nothing at all on these wide, dry areas. Where rainfall is less than twenty inches per year, dry farming or irrigation must be practiced.

Irrigation. Two-fifths of the land of the United States is too dry to produce regular crops without irrigation. By irrigation is meant the storing of water in lakes and reservoirs by means of huge dams. This is done in the rainy season, when there is plenty to be had. This water is then turned on the fields by means of ditches when crops are growing, where it takes the place of rainfall (Fig. 56). Some reservoirs are supplied from rivers that flow

the year round, while others must be filled in the rainy season. The United States Government is

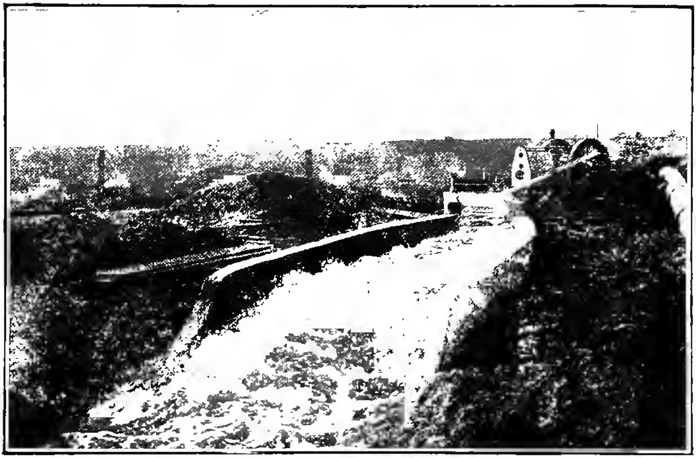


FIG. 56. *A private irrigation plant.*

spending millions of dollars in the dry sections to save for crops some of the water that is going to waste.

Making Machinery Better. A slight improvement on the crooked stick was a rude plow made from several sticks bound with thongs of skin. This was used after the ox had been taught to bear the yoke. Farming with such tools was hard and toilsome labor with little reward. A brush dragged over the plowed ground was probably the first harrow.

Copper Tools. It was a great step forward when some one learned to smelt copper. Though copper

is soft and will not take on a sharp edge, yet it made far better tools than did sticks. The next step was made when it was found that by mixing tin ore with copper a much harder tool could be made, with a better edge. This mixture is called bronze. Bronze tools were used for untold ages until some clever man found out how to make a fire hot enough to smelt iron ore. When iron tools and weapons were made, we have the beginning of all the wonderful machinery in use to-day.

The First Iron Tools. Iron tools were few and costly at first, because the warriors needed all the iron they could get for their weapons. But men learned at last to make hillside furnaces for smelting iron ore, and then the farmer got a few iron

FIG. 57. *Put the soil in good tilth with a disk harrow before sowing.*

tools. The day came when some clever farmer put an iron share on his plow to cut the soil. From that day to this men have gradually improved iron farm tools, and the splendid horse-power machines of all

FIG. 58. *A tractor engine drawing four plows.*

descriptions which do farm work to-day are the result of the wonderful inventions of many bright minds.

Farm Machinery of To-Day. The poorest farmer of to-day has a plow to turn the sod and stir the soil deeply; he has a cultivator to tear and break the soil, and a harrow to make it fine like ashes for the dust mulch (Fig. 57). Certain soils that

are sandy and too loose need rollers to pack them slightly. Every sort of harvester has been devised for gathering the crop. But farmers have not been content with horse power alone. They have harnessed the wind to their windmills, they have hitched their plows and harvesters to great steam engines (Fig. 58), and they are using the power of gasoline engines to do many kinds of work about the farm (Fig. 59). Even electricity may be had where there is a waterfall to make it cheaply.

Care of Machinery. It is important that the farmer take good care of his machinery and tools. More plows have been rusted out by the weather than have been worn out by use. There are three good rules for every farm. Keep all tools under a good roof when they are not in use. See that all machinery, wagons, and the like are kept well

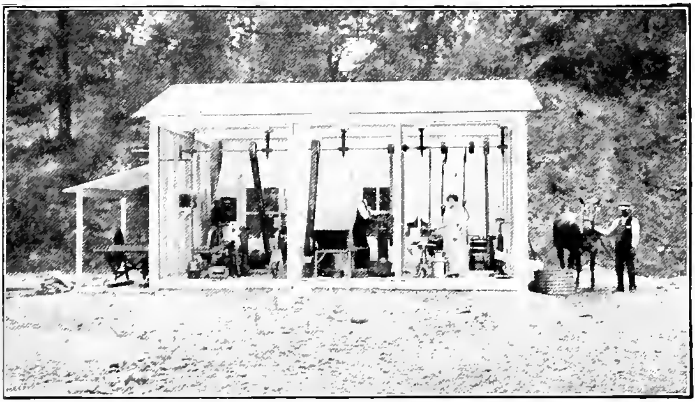


FIG. 59. *A gas engine is a great labor saver on the farm.*

painted, so they will last longer and save the farmer from buying new ones early. Use plenty of oil to save wear on all machinery. Oil and paint cost money; but if thirty-five cents' worth of paint will make a thirty-five-dollar machine last several years longer, it pays to use the paint.

CHAPTER XIV

CORN

America and Corn Discovered. When Columbus sailed toward the west over the unknown ocean, he hoped to reach the rich cities of Asia and the Spice Islands. Here he expected to obtain a rich cargo of spices, some of which were worth their weight in gold. But, instead of reaching China, Columbus landed upon a new world where white men had never been before. Instead of rich cities, he found only a vast wilderness inhabited by savages whom he named Indians. The Indians lived by hunting and fishing and by raising a few plants which were new and strange to Columbus and his sailors. These were squashes, tobacco, and maize, or corn. Columbus never knew what a wonderful golden treasure he had found in this Indian corn. It has come to be one of the most valuable crops in the world. When the corn crops fail there is a scarcity of food for rich and poor and hard times for everybody for many months.

Corn Saves the Pioneers. This Indian corn was a great blessing to the early immigrants from Europe, for the wheat and rye which they had brought with them would grow only in well-tilled fields and these pioneers were poor farmers with poor tools. There were no well-tilled fields, and men would not work.

They would have starved if the Indians had not furnished them with corn. The Indians taught the white men from Europe how to raise corn and how to make from it dishes fit for a king to eat.

Indian Farming. The Indian methods of farming were very crude and simple, for they knew very little about tilling the soil. The Indian squaws killed a patch of forest trees by cutting a girdle around each one when the sap was running in the spring. After the trees died and the sunlight shone in, the squaws scratched the grains of seed corn into the ground, with a crooked, sharp stick for a hoe. Here, without the use of plow or harrow, the corn sprang up in the rich earth, and a harvest of yellow ears provided food for winter.

Where Corn Grows. Since that time corn has been one of the chief crops of the American farmer in most sections, and to-day it is the most important of all. Corn can be raised in nearly every part of North America. In the North, where the summers are short, the farmers have developed a kind that grows only three or four feet high and that will ripen in seventy days. In the Southern countries of Mexico and South America there are kinds of corn that grow more than twenty feet high and require six months in which to ripen.

The Corn Belt. Corn is now raised in many countries, but about three-fourths of the world's supply is grown in the United States, and nearly one-half of the world's supply in the seven states known as

the Corn Belt. They are Illinois, Iowa, Nebraska, Missouri, Kansas, Indiana, and Ohio. The Corn Belt supplies many other states and countries with its surplus of corn. Besides a good soil in which to grow, corn needs hot weather with long days of bright sunshine and a great amount of rain.

A Corn Train. If the corn crop of the United States in 1912 had been placed in wagons, with fifty bushels in each load, and each wagon and team had been allowed twenty feet of space, the train of corn would have reached more than nine times around the earth at the equator.

Corn Land Valuable. Where corn thrives, it yields about twice as much food for each acre as is produced by any of the other grains. That is the reason why land in the Corn Belt is very high in price. Corn is grown in many places where only a half-crop is obtained, for a half-crop of corn yields as much food as a full crop of wheat or rye.

Choosing Good Seed. It is believed that the farmers in any state in the Union could increase the yield of corn from five to twenty bushels an acre if they were trained in choosing their seed corn. In order to choose well the farmer must be a good judge of an ear of corn. To know a prize ear is not such a difficult lesson to learn.

The Prize Ear. A perfect ear should be round, tapering, and full and strong in the middle. It must be firm to the touch, and the kernels should not be loose on the cob, as this shows that the ear

is not thoroughly ripened. The distance around the ear one-third of the distance from the butt should be about three-fourths of the entire length. The rows of kernels must be straight, and there should not be fewer than sixteen nor more than twenty-eight rows on the cob. In most sections the ear is from eight and one-half to ten inches long, and it should be filled out to the tip (Fig. 60).

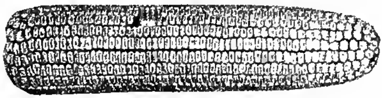


FIG. 60. *A prize ear.*

Good Kernels. The kernels to be planted should be wedge-shaped, with the edges touching those next to them their entire length from crown to cob. They should have deeply indented crowns without pointed or sharp corners. The color needs to be true to variety and free from mixture.

Cobs. Ordinary types of white corn should have

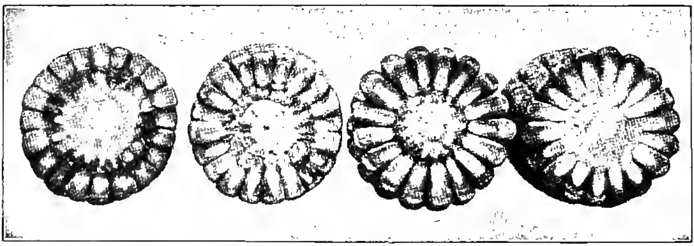


FIG. 61. *A cob may be too large or too small.*

white cobs, and yellow corn should have red cobs. However, certain varieties of types vary from this

rule. The deeper or longer the kernel, the greater the proportion of corn to cob. An extremely large cob means late maturity and less corn in proportion to cob (Fig. 61). The ears should carry their size well out to the tips. The wider the furrows between the rows of grain on the cob, the lower the proportion of corn to cob (Fig. 62).

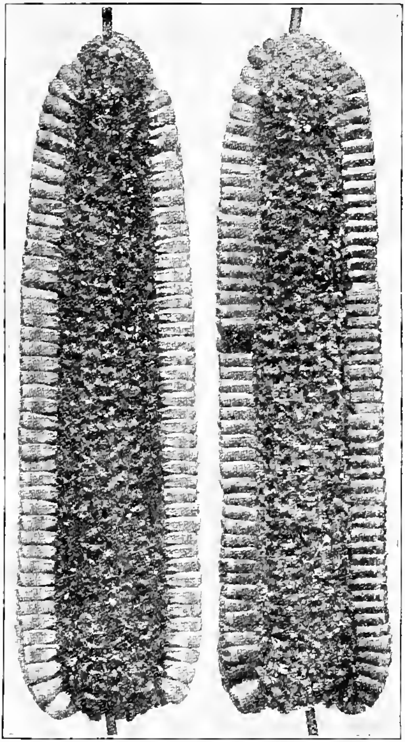


FIG. 62. *Space between kernels next to cob, objectionable. Ears Nos. 1 and 2 are same length and circumference. Ear No. 2 shelled out 33 per cent more corn by weight than No. 1.*

When to Select Seed. Some farmers are satisfied to choose the finest ears from the crib, but a better way is to select from the fields at husking time. By taking seed from stalks bearing two well-formed ears, the next crop will have more two-eared plants, and thus the crop will be larger. In order to choose seed for any crop, it is safer to see the plant on which it grew,

because like produces like. Careful selection of seed is the most profitable farm work.

Curing the Seed. Every ear intended for planting must be gathered before the autumn freezes, since freezing corn that is not well dried injures the seed germ. Seed corn should be hung up where the air can circulate about it freely. A good place to hang seed corn is in the attic over the kitchen, with the windows open.

The Corn Tree. The "corn tree" is a device for drying corn. It consists of an upright post driven full of small-headed nails. An ear of corn is easily stuck on each nail by jamming it into the pith at the butt end. A wall driven full of nails will serve the same purpose of holding the ears apart so they will dry quickly.

Testing Seeds. Every ear intended for seed should be tested to see if the corn will sprout or germinate. Take six seeds from each ear and plant them for a test, keeping the ear marked by number. This will insure a good stand and prevent replanting, which causes a spotted field and a poor and uneven crop (Fig. 63).

Improving Corn. A good way to improve the variety is to plant the seed from the hundred best ears on one side of the field and to choose the seed for the next year from this planting. In this way a farmer will improve his crop every year.

Planting Evenly. To-day most farmers plant with machines, and the planter will not drop the corn

evenly unless the kernels are of the same size. It is, therefore, wise to shell off and discard the kernels

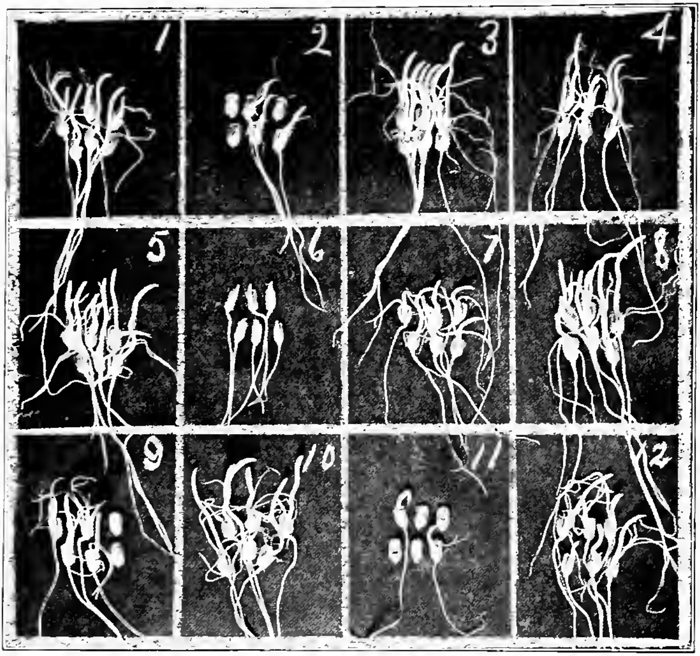


FIG. 63. *Testing twelve ears of seed corn.*

on both the tip and butt of the ear which are of irregular size and shape. The corn grader is a machine which will do this work of sifting out the poorly-shaped kernels, or it may be done by hand if the crop is small. It is a good plan to test the corn planter to be sure it will drop three kernels in a hill.

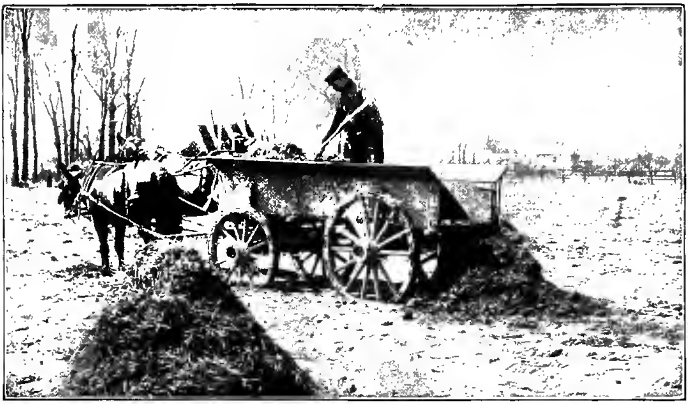


FIG. 64. *The old way of spreading manure leaves the field unevenly fertilized and the crop grows and ripens unevenly.*

Making the Soil Rich. The farmer prepares his fields well before sowing. He adds to the soil by spreading over it barn-yard manure, for manure contains the most plant food of anything he can put on his fields (Figs. 64 and 65). Instead of spreading manure on the corn lot, the farmer may choose fields to plant where he has the year before raised a crop of clover or cowpeas, because he knows that these two crops enrich the soil for corn (Fig. 53). Sometimes he buys a fertilizer made of certain foods which the plant needs, but this costs a great deal of money.

How to Plow. To prepare the ground the good farmer plows rather deep to bring fresh soil up to the air and sunshine. The air and sunshine help to make the plant food ready for the little corn rootlets

to take up. The ground should not be plowed when the soil is very wet, for it stays in hard lumps and is not easily broken up so the roots can reach into the earth.

How to Keep the Ground Moist. The plow is followed by a disk or spring-tooth harrow (Fig. 66) until all clods are broken and the surface is mellow and fine like ashes. This ashy top soil acts like a blanket to keep the moisture in the ground from escaping.

Planting the Crop. Field corn should be planted in rows about three and one-half feet apart. Years ago a few grains of seed were dropped into each hill by hand and covered with a hoe, but to-day the farmer uses a checkrow planter drawn by a team.

FIG. 65. *Manure should be spread evenly.*

This machine plants the corn so it can be cultivated both ways and be kept clean more easily.

Keeping the Weeds Down. A few days after planting, the field should be harrowed to kill the grass and weeds that are ready to sprout, because they grow faster than the corn. When the corn is a few inches high the harrow must be used again to break the crust and to supply air to the soil as well as to keep the weeds and grass down.

Plowing the Corn. The field should be cultivated two or three times more, but after the corn roots have spread out between the rows, it is not safe to plow too close to the row or too deep, for fear of breaking off millions of little rootlets that are feeding the plant. This applies also to the raising of sweet corn or pop corn and other crops needing tillage.

FIG. 66. *Spring-tooth harrow.*

Gathering the Crop. When the lower leaves on the stalks begin to die, the corn is ready to cut.

FIG. 67. *The corn cutter.*

This may be done with a hand cutter or with a corn harvester (Fig. 67). About sixty hills are cut and gathered into one shock. The tops are bound together so the shock will stand while the corn cures, which requires about six weeks. When the leaves are dry the husking takes place, and the ears are stored in well-ventilated cribs built high from the ground and protected from the rats and mice. Send to the Department of Agriculture for plans for the crib.

Saving It All. In some places the corn is husked, or picked, standing in the field and the cornstalks are burned. This is a great waste, for cornstalks make good food for horses, cattle, and sheep, and they like it very much. A machine which husks the corn and shreds the tops and leaves makes a feed called corn stover that is as good for live stock as timothy hay. Making fodder into stover saves it all.

FIG. 68. *Filling the silo.*

A Great Discovery. Every farmer knows that cattle like green feed much better than dry. But for a long time nobody knew how to keep feed green through the winter. Many years ago, in Europe, a stack of wet, green grass was covered with earth by accident. When winter came this stack was uncovered and the grass was still green and juicy. It was greatly relished by the cattle.

Building Silos. After that, farmers began to dig pits in the ground to keep feed green. Such pits were called silos, and to-day they are made above ground of cement or wood and placed near the cattle barns (Fig. 68). Cattle will eat more silage than fodder, and cows fed on it give more milk. When corn is grown for the silo it is planted about one stalk every seven inches. in rows three and one-half feet apart.

Corn a Treasure. Corn is the backbone of farming in our country. Not only is it good for live stock of all kinds, but it feeds more people than any other grain except rice. Many useful things are made from corn besides the fodder, grain, and meal for feeding. The silks are used in the making of filters, and corn husks are made into mattresses. Pith is used for the packing of cofferdams of battleships. Oil, varnish, starch, alcohol, and many other articles are made from corn. There is one factory in the United States that makes forty-two different corn products.

CHAPTER XV

WHEAT

White Bread. Nearly the entire wheat crop of the world is used for human food. Wheat bread is such a common food in our country now that we do not realize that it is still considered a great treat by some classes of people in other parts of the world. The poor peasants in many lands eat bread made of rye, barley, or millet, because it is cheaper than "white bread." Millions of people in Asia eat rice, but wheat flour makes a light bread that is more healthful and tempting than that made by any other grain; and as fast as the poor classes of people can afford it, they demand wheat bread.

The First Wheat Farmers. Who the first people were to raise wheat we do not know, because it happened, like so many other interesting things, before men learned to write. Neither do we know where it first grew. The ancient lake-dwellers of Switzerland raised a kind of grain very much like our wheat. Some scholars believe that the early home of wheat was in the Euphrates Valley, in western Asia. Others think it first grew in Palestine. A kind of wheat has lately been found growing wild on the mountains of Palestine, and some people are sure that our wheat has come from this wild kind. Wheat was grown in China many hundred years

before Christ lived, and the Chinese said that it was given to them direct from heaven.

Wheat in America. Wheat was the first grain brought to our country by the Jamestown colony in 1607. These pioneers cut down forest trees to build a fort, and in the cleared places they sowed

Fig. 69. *The reap hook, an ancient tool for reaping grain.*

wheat. The first crops were very poor, but they wanted white bread, so they kept planting a little more each year. The crops were cut with the reap hook, or sickle, which is merely a knife with a curved blade (Fig. 69). It was threshed by being trod upon by horses and oxen.

The World's Crop. Our country does not produce so large a part of the world's wheat crop as it does of the corn. Europe raises twice as much wheat as does North America. European countries get twice

as much from an acre as we do, so they can raise it as cheaply as we do on our large farms in the West.

Kinds of Wheat. There are several kinds of wheat. Some kinds are sown in the fall and remain on the field through the winter. Such kinds are called winter wheat. Others are sown in the spring and are called spring wheat.

Climate. Wheat is better suited to short summers than is corn, so it can be grown much farther north. For several years farmers have been moving by hundreds to the wide prairies of western Canada for this purpose, and they are making it a great wheat country.

Preparing the Soil. This crop will grow on a great variety of soils, but it seems to thrive best on a light clay. The land that is to be used for winter wheat needs to be plowed as early in the summer as possible. Such early plowing loosens the ground so it will hold more moisture. The soil should be made fine and loose. For spring wheat one may plow the fall before, or early in the spring.

Sowing the Seed. Winter wheat is sown early in the fall, so that it may grow strong before the cold weather comes. Spring wheat should also be sown early, because wheat will sprout and begin its growth while the weather is still cool. Six to eight pecks of wheat are sown to the acre, and the seed is planted about two inches deep. The lighter and looser the soil, the deeper should be the planting. In olden times wheat was scattered by hand and

harrowed in, but now it is nearly all sown by the drill (Fig. 70).

Cultivation. In most countries wheat receives no cultivation between the sowing and the harvesting. In some places it is harrowed or rolled after the seed has begun to sprout or after it has taken firm

FIG. 70. *A wheat drill.*

root. This is done to kill weeds and to keep moisture in the ground, as we do for corn. But most wheat farmers think this does more harm than good. In Japan wheat is planted in wide rows and hoed. Vegetables are raised between the rows. A hundred years ago wheat was hoed with a mattock. Wheat may be pastured in the winter when the ground is frozen, but not late in the spring.

FIG. 71. *The cradle was a great improvement over the reap hook.*

Wheat in Rotation. Wheat should never be grown on the same fields year after year with no change of crop. It was grown in England for many years to test this. When it was grown on the same field every year for twelve years the average crop was a little more than twelve bushels to the acre. When it was grown every fourth year, with three other crops between, the yield for each acre was twenty-eight bushels, or more than twice as much.

Enemies of Wheat. Wheat seems to have more enemies than any other crop that the farmer raises. He never knows when he sows his fields what he shall reap or whether he shall reap at all. Very hot or cold weather may ruin the crop. Drouths may come and the plants die of thirst; or it may rain too much and drown the wheat. Storms of hail or wind

or floods may ruin it. Smut, or rust, or insects may devour it. The farmer has more risks to run in growing wheat than in almost any other farm crop, yet mankind is willing to pay extra for wheat bread.

Harvest Home. In most regions wheat must be harvested very promptly, or much of the crop may be damaged or lost. Before good machinery was invented it was a very toilsome task to gather the wheat crop. So much hard work had been put into it and such a long time had gone by since the grain was sowed that the farmer was always anxious at harvest time to reap his crop and pay his expenses. At the close of the season the people held great rejoicings, called in England "harvest home." They formed a procession, with music, to bring home the last sheaves of grain. The workers and

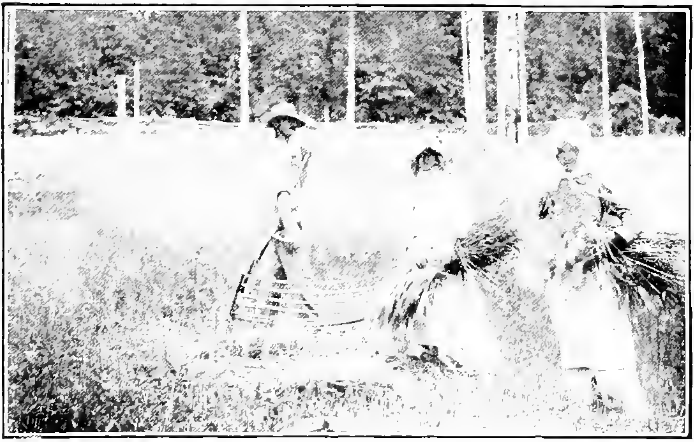


FIG. 72. *Cutting wheat with a cradle.*

pretty maidens danced along, merrily singing:

> "Harvest home, harvest home,
> We have plowed, we have sowed,
> We have reaped, we have mowed,
> We have brought home every load,
> Hip, hip, hip, harvest home."

The Sickle. We have said that many years ago wheat was cut with a reap hook, or sickle, held in one hand (Fig. 69). A large part of the world's crop is still cut in that way among the peasants of Russia, China, and Japan. With a sickle a good worker can cut about an acre a day.

The Scythe or Cradle. The Romans thought they could cut more if they had a longer blade and used both hands, so they invented the scythe. This allowed the grain to fall over when it was cut and some clever man placed wooden fingers above the scythe to catch the grain and help to lay it straight for binding. This was called the cradle. It is still in use in many places in our country for cutting small patches of oats and wheat (Figs. 71 and 72).

Animal Power. But the cradle used only hand power, and men needed horse power to save both time and money. The first machine to use animal power was a wheat-header used in France about the time of Christ. It was a two-wheeled cart, pushed by an ox yoked behind. On the front edge of the cart were sharp fingers, or teeth, like a big comb, to catch the heads of wheat and pull them off and rake them into the cart. This machine later disappeared.

The Header. Hundreds of years later men began to make machines with the power in front. This method with horse power meant a side-cut. The wheat-header is a machine that cuts off the heads and throws them into a wagon that is driven alongside. It saves binding and shocking. Wheat must be dry before it is cut in this way, for the grain is either stacked or threshed at once without time for curing. If it be damp, green, or weedy, it will not thresh well and is liable to spoil in the stack. The header is chiefly used in dry countries. The header of to-day cuts a strip twelve to twenty feet wide. In the state of Washington three headers and one threshing machine usually work together on the mammoth farms. In this way from fifty to seventy-five acres of wheat are harvested in one day.

The Reaper. Another machine has been worked out to harvest the wheat where the header is not successful. A machine was developed that would cut and bunch the grain. This was called the reaper (Fig. 73). McCormick's machine was first used in the harvest of 1831. It was a rather crude affair, drawn by one horse, but it was a good beginning. It meant cheap bread for mankind, but the farmers at first refused to use the reaper. They laughed at it; they said it would not work on hillsides. But they sat on the fence and watched it. Then they shook their heads and went back to their old cradles. McCormick talked and urged the people to try it, but it was ten years after the machine proved itself

before a farmer was found who would buy one. The next year two reapers were sold, then fifty, then a thousand. The grain was raked from the platform of the machine by a man walking behind. It had to be bound and shocked by hand. Not long afterwards larger and better machines were made. It took

FIG. 73. *The first reaper.*

much hard work to change the reaper into the modern binder (Fig. 74).

The Self-binder. The machine in general use in our country to-day is the self-binder, which cuts, binds, and dumps the bundles in piles to be shocked by hand (Fig. 75). On some of the large grain farms there are as many as fifty self-binders, and these often cut six hundred acres of wheat in one day. To make a device that would bind the wheat was a hard task. Finally one was made that would

do the work, but it bound the bundles with wire. Pieces of wire found their way into the throats of cattle, and farmers would not buy the binder. Some cheap binder twine must be found. Mr. William Deering spent much time and a great deal of money to get a twine that would knot easily and firmly.

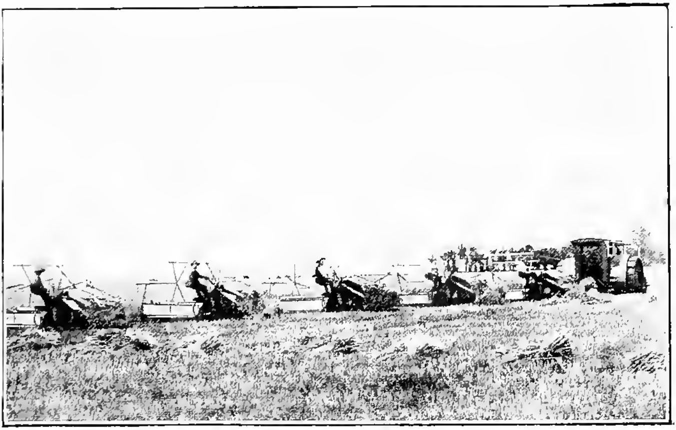


FIG. 74. *The modern binder drawn by a traction engine.*

He finally found that Manila hemp would act just right, and this made the binder complete. Our binder twine is usually made of a mixture of Manila and sisal fiber. Millions and millions of pounds of binder twine are used every harvest.

Combined Harvesters. The most complete machine of all is the combined harvester, which is used chiefly on the bonanza farms on our Pacific coast, where there is nothing to fear from rainy weather. This machine cuts, binds, gathers, cleans, and bags

the grain without a single touch from human hands. On one side the wheat is cut, and on the other sacks of wheat are dropped in piles ready for the market. This machine is drawn by great teams of from twenty-four to forty horses and mules, and it har-

FIG. 75. *Shocks of golden grain.*

vests from thirty to forty acres of grain a day. It requires only four men to operate it.

Steam Harvesters. There are large combined harvesters run by steam. They harvest from seventy-five to one hundred twenty-five acres a day. They are used only on very large farms, from three thousand to twenty thousand acres each. In the days of the old Romans it took four days and a half of

work to raise and harvest each bushel of wheat. When the reaper was invented it took three hours of labor for each bushel, and to-day it takes only ten minutes. This is what machinery has done for the farmers.

How Much We Eat. It is said that, on the average, every person in the United States eats about five bushels of wheat in a year. Five bushels of wheat make a barrel of flour, and a barrel of flour turned over to the baker makes about two hundred fifty loaves of bread.

Other Uses of Wheat. Most of the American wheat is made into bread, but there is also a great amount used for breakfast foods. Some wheat is fed to stock, especially to poultry. Wheat, bran, and middlings in great quantities are bought at the mills and fed to cattle. Macaroni is made from wheat, and so is starch, which is used for paste or sizing. The straw is used for feeding and bedding cattle and for making straw hats and bonnets.

A New Kind. Some man of knowledge has now developed from the wild wheat of Palestine a type of wheat that will grow in dry climates. If this new type is truly successful it will be a great blessing to mankind, for the people who want "white bread" are increasing much faster than the world's crop.

CHAPTER XVI

THE FIELD OR IRISH POTATO

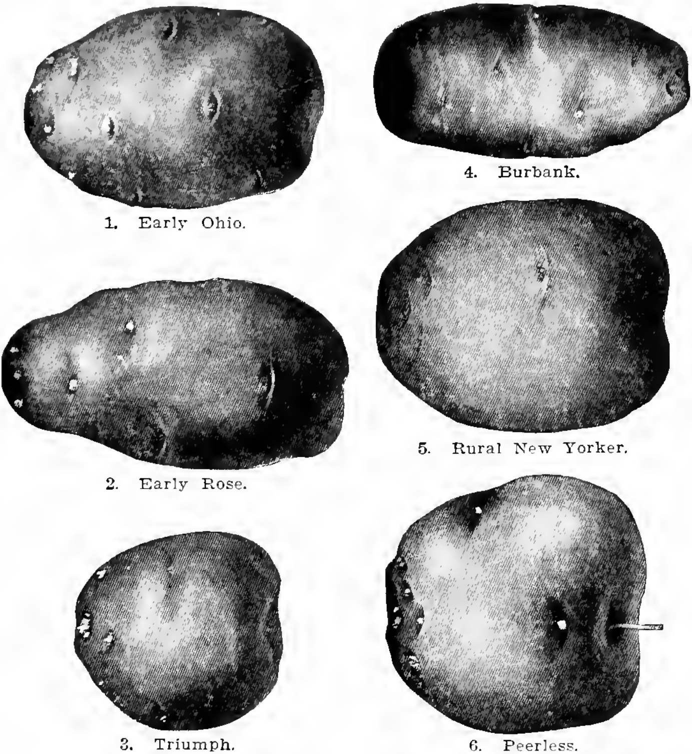
The Potato's Early Home. The early home of the potato was in America. White men had never seen it until after the discovery of the continent by Columbus. The Indians of South America, from Chili to Colombia, were raising potatoes for food. How long they had been doing this we do not know. The Spanish explorers carried the potato to Europe, where it was first grown in Spain and Italy.

The Potato in Ireland. Some years later, we are told, Sir Walter Raleigh was cultivating it on his farm in Ireland. He called it "Battata." The potato came to be raised as the principal article of food in Ireland; and when, in 1846, there came a total failure of the potato crop, caused by the blight, a terrible famine and great suffering followed. It drove thousands of Ireland's best thinkers and workers to America.

A Widely-grown Crop. Potatoes are a more important crop in Europe than in America, and it is a staple product in many lands besides our own. Next to rice, it is probably the most widely-grown crop in the world.

Not a Root, But a Tuber. The part of the potato that we eat is an underground stem which is called a tuber. It is not a root, like the sweet potato or

radish, for there are no rootlets growing upon the white potato. All the roots are found extending out from the stems.



1. Early Ohio.
2. Early Rose.
3. Triumph.
4. Burbank.
5. Rural New Yorker.
6. Peerless.

Courtesy of Agricultural Experiment Station, Wisconsin

Fig. 76. *Standard varieties of potatoes. Early varieties, 1, 2, and 3. Late varieties, 4, 5, and 6.*

The Kinds of Seed. The potato can be raised both from the seeds which grow in the seed ball at the

end of the stalk and from the tubers. The farmer always plants tubers, because they produce other tubers just like themselves. The potatoes grown from the seed do not always come true to the variety.

The Potato Eye. Each eye of the potato will grow a new plant if a piece of potato is left on it large enough to feed the young plant until it can put out strong roots. When potatoes are allowed to sprout in the cellar they use up some of their plant food so they shrivel. These potatoes should not be used for planting.

Cutting the Seed. Irish potatoes are usually cut into two or more pieces for planting. Some careful farmers cut two eyes to each piece; others claim it pays to use more seed and take a half potato for each hill. The seed is best cut a short time before it is put into the ground. One experiment station found an increase of fifty-four bushels per acre by placing the potatoes in a well-lighted room with a comfortable temperature for several weeks before planting.

How to Choose Seed Potatoes. Our plants grow from the bud in the eye of the potato, and so we should know just what kind of a plant the seed potato grew on. We must see to it that we choose seed taken from vines that are good producers. Some vines have twice as many potatoes as others. Therefore, we select our seed potatoes, as we do corn, not from the bin, but from the potato field, as

they are dug. It matters not if the seed potato be large or small if it came from a hill bearing a large

Courtesy of U. S. Dept. of Agriculture

FIG. 77. *Colorado potato beetle at work on the plant: a, beetle; b, egg masses; c, half-grown larvae; d, mature larvae.*

yield of fine potatoes. By careful selection, year after year, a farmer can greatly improve his variety

and produce larger crops on the same space of ground (Fig. 76).

Climate and Soil. For the best crop one needs a deep, fertile soil with plenty of moisture, but not too wet. A cool climate is most suitable. The seed-eyes are planted from two to five inches deep, and the most successful growers do not hill up the plants until late in the season. Moisture is held better if the ground is kept level.

Cultivating the Crop. A few days after planting a harrow or weeder is run over the field to destroy all weeds as soon as they are started. This weeder is used once a week until the plants are six or eight inches high. Then the fields are cultivated between the rows about every ten days.

Insect Enemies. One of the first enemies the plant meets after it appears through the surface is the flea beetle that gnaws small holes in the leaves. They may be checked by spraying with the Bordeaux mixture or with Paris green. This remedy will also stop the ravages of the potato beetle, or Colorado bug (Fig. 77). Potatoes are commonly sprayed about five times, beginning when the plants are about six inches high and repeating the operation every ten days.

The Potato Scab. Another enemy of the potato is the scab, which is a very tiny plant growing on the surface of the tuber. Scabby potatoes do not bring good prices. If seed potatoes are given a bath in a solution of formalin for about two hours

before they are planted, the formalin will kill the scab growth without injuring the potatoes. One-half pint of formalin to fifteen gallons of water makes a proper solution, which will do for several bushels of potatoes, as it can be used over and over again.

The Blight. Another disease for the potato farmer to guard against is the blight. This is a tiny plant

Courtesy of Agricultural Experiment Station, Wisconsin

FIG. 78. *A field of potatoes yielding 350 bushels per acre.*

or fungus growth which attacks the plant above ground. The blight sometimes destroys a crop completely. Spraying is the remedy for this enemy, also.

Harvesting. Early varieties of the potato are dug as soon as they are big enough for market. Late potatoes are left in the ground until the vines are

dead. They should be gathered when the ground is dry and placed in a dark, cool place. Potatoes stored in the cellar should always be covered to keep the light from burning them. In some regions farmers raise from three hundred to five hundred bushels per acre (Fig. 78).

Potato Machinery. In order to grow potatoes profitably, one must plant a good many acres to afford the machines needed. A potato planter, a sprayer, and a digger are needed, and the wear on these tools amounts to thirty or forty dollars a year.

Uses of Potatoes. Potatoes are used mostly for human food, but they make good rations for stock, either raw or cooked. Alcohol and starch are made from potatoes.

CHAPTER XVII

THE SWEET POTATO

The Sweet Potato a Root. The sweet potato is not related to the Irish potato. It is not a tuber, but a true root grown large. Instead of eyes it has small rootlets running out from it. The sweet potato has blossoms very like the flowers of the morning glory, and it belongs to the same family of plants.

Its Home. The sweet potato seems to have first come from the warm regions of America. It is now raised principally in the Southern states and upon islands in the Pacific Ocean.

Climate and Soil. Four months of mild weather without cold winds or frost are needed to grow sweet potatoes. They will thrive in almost any loose, well-drained soil, if the climate is warm. A light sandy loam gives a cleaner potato, and these are the best sellers.

Planting. For a new crop, all of the sweet potato may be planted. They are usually started in a hot-bed, and sprouts or young plants are transplanted, or taken up and set out again, in the field in rows about three feet apart.

Cultivation. It makes very little difference what crop has just been taken off the field that is to be put to sweet potatoes, but it is unwise to have them follow sod, because sod ground contains many cut

worms that harm this plant. It is not necessary to plow deeply, but all weeds must be kept down by good cultivation until the potato vines cover the ground.

Harvesting. The sweet potato, like the apple, is easily damaged by bruising. Extreme care must be used in handling them. All bruised potatoes should be laid aside for immediate use. Those intended for the market may be graded—that is, the large ones should be separated from the small ones. Time spent in grading and packing is worth while, for this care brings better prices.

Storing the Crop. Sweet potatoes are hard to store, because they rot so easily. They should be partly dried and cleaned and then placed in a dry, warm bin. If all bruised ones and those that are beginning to rot are removed from the bin, they will keep for some time.

Uses of the Plant. Sweet potato vines make a very good hay that is sometimes used as ensilage for filling silos. Potatoes too small to sell may be fed to stock, for they are rich in sugar and starch. Sweet potatoes are largely used on the table, but some are dried and ground into flour and some made into starch, glucose, and alcohol.

There are eighty different varieties of sweet potatoes. The kinds that are dry and mealy are preferred in the North, while the juicy, sugary varieties are most popular in the South.

CHAPTER XVIII

COTTON

The Home of Cotton. Our great-grandmothers grew cotton in their front dooryards as a flowering plant. It is supposed to be a native of India. But Columbus found some kinds growing here when he came to America. Now it is one of the important crops of the Southern farmer.

Climate. Cotton is a warm-weather plant and needs a rather long growing season. Warm, moist nights with the weather becoming warmer is best for the growing plant; while later, when the fruit is setting and ripening, dry weather with occasional showers is better. Too much rain when the fruit is ripening causes the stalk to grow too large, and the bolls are then late in ripening.

The Best Soil. Cotton grows best on a clay loam or sandy loam soil that is well drained. On bottom land which overflows stalks sometimes grow so large and become so tough that they have to be cut down with axes before the land can be cleared and plowed for another crop. Good cotton land must hold moisture well. There should be much humus in it and a good dust mulch on top. It is well to plant peanuts or some bush variety of cowpeas between the cotton rows and plow them under with the cotton stalks after the cotton has been picked. This will

help to maintain the humus. But clover grows well in winter in the Southern states, and it can be used to follow the cotton. It is plowed under the following spring.

Preparing the Soil. Early fall plowing is best where one cotton crop is to follow another. In this way the cotton stalks and the weeds are plowed under. This enriches the soil and kills the boll weevil and other insects. Where the stalks grow large, it may be best to clear the stalks from the land and burn them. But usually they should be cut and turned under with the plow. On many plantations cotton is grown on the same land year after year. In such cases it is usually necessary to fertilize the soil. When the seed of the cotton plant is used on the same farm for feed and only the lint is sold, the stock that is fed on cotton seed helps to furnish fertilizer in the form of manure. This should be saved and put back on the land. But in the far South cattle are not kept in stables, but in the open pastures, and it is, therefore, difficult to save the manure for the cotton fields.

Keeping the Soil Rich. Experiment stations have tested and decided that cowpeas, peanuts, and clover and alfalfa may be grown in a three-year rotation with corn and cotton. This will keep up the nitrogen in the soil. Some have found that potash and acid potash make good fertilizer for many fields.

Deep Plowing. Planting begins in the early spring, as soon as the frost is over. In Texas this

is in March, in North Carolina not till May. The cotton plant has a tap-root that reaches as deeply into the ground as the loose soil will permit. So if the ground is not loose, deep plowing is worth while to give the roots moisture and air. Harrowing till the ground is fine destroys many weeds and makes a dust mulch that saves moisture for the growing plants.

Putting in the Seed. On many fields it is best to plant the seed on beds or ridges thrown up about four feet apart. On dry soils the ground should be kept level. It has been found that four feet is the correct distance between rows, and the plants grow best from twelve to eighteen inches apart. This will leave room for the bushy top that comes later. Early planting is very necessary wherever cotton is raised and plenty of seed to make sure of a good stand. Not less than thirty pounds per acre should be planted. As soon as the plants are well started and all danger from frosts is past, the plants are thinned with the hoe till they are the correct distance apart. In the olden days a negro plowed the ground with a plow and mule, dropped in the seed, and covered it by hand. Good farm machinery now makes planting easier. On some of the plantations to-day all the work is done by one machine which opens the furrow, drops in the seed and fertilizer, and covers it all in one trip. Most of the work is done by the hands of colored laborers.

Cultivation. The cotton field should be cultivated

frequently, but not too deep, until the plants begin to mature bolls (Fig. 79). Even after the bolls appear it is well to keep a crust from forming on the ground. But if the land was well prepared before the crop was planted, it can be laid by, because the early tilling served to lay up sufficient moisture and to prepare plenty of plant food to mature the boll.

FIG. 79. *A cotton boll and leaf.*

Ready to Pick. Eight or ten weeks after planting the cotton is in flower (Fig. 80). The cream-white blossoms soon turn to a pinkish or reddish color and drop off. The seed pods which form are the size of an English walnut. When these are ripe they burst open like milkweed pods, and the cotton is ready for picking (Fig. 81).

Harvesting. Texas planters begin to pick cotton about the middle of July. More northern states harvest from four to six weeks later. No machine has been invented that can do this work well, so the picking is done by hand. The work is hard and tiresome. Many negroes are used, because they stand the heat better. They are paid from thirty to fifty cents a hundred pounds. Since cotton does not ripen all at once, a field has to be picked many times before the frost destroys what is left. If all is left standing to be picked at the same time, it is apt to be injured by dust and rains. Cotton may be picked as late as December in the warmer region about the gulf.

FIG. 80. *A blossom of the cotton plant.*

Eli Whitney. The white thread of the cotton boll is filled with small dark seeds nearly twice the size of an apple seed. When these were picked out by hand a workman cleaned about a pound a day.

Eli Whitney was a graduate of Yale College who went South to spend the winter. One dark night at a social gathering he heard the Southern planters talking about what a drawback the taking out of the seeds was to cotton raising. This was the first time Whitney had ever seen cotton or cottonseed, but he began to work on a machine for the purpose of separating them.

The Cotton Gin. Whitney's new machine was a wooden cylinder on which were fastened hooks arranged like the teeth of a saw. When the cylinder was turned these hooks passed between the wires of an upright frame and pulled the fiber of the cotton through, while the seeds fell to the ground on the other side. Improvements were soon made on this machine. Now the cotton fiber is pulled from the teeth and blown into the press room free from dust and seed.

Baling Cotton for Market. Here in the press room it is baled in hard, round bales of about five hundred pounds for market. The cotton is pressed very close to save shipping and to prevent it from easily catching fire. One-half of our raw cotton is shipped to European countries where they make muslins and finer materials than are made in the United States.

Use of Seeds. From every pound of lint about two pounds of seeds are removed. In the cottonseed mill the seeds are crushed, and the oil which is pressed out is sold in large quantities for various purposes. It is often used instead of lard or mixed with it.

One-third of the oil is bought by packing houses and used in this way to make lard. It is also used in the manufacture of butterine and in place of olive oil. Fish are packed in it. The poor product, that cannot be put to better use, is made into soap.

Oil Meal. After the oil is crushed out, the rest

Courtesy of Hilliard Land Company, Florida

FIG. 81. *A cotton field ready for pickers.*

of the seed is ground into meal which is used instead of corn to feed to cattle. In this way the Southern farmer feeds his cattle from his own produce, instead of buying grain. It is said that the meal from a bushel of cottonseed has as much food value as a bushel of corn. When the corn crop fails in the West, farmers import cottonseed. It is also valuable

for fertilizer. Two tons and a half of cottonseed hulls equal a cord of wood for fuel. Such fuel is used in Southern factories. The ashes are then used for fertilizer in raising tobacco.

Two Kinds Most Raised. Sea-island cotton is so called because it requires the salt sea air to thrive. It is the best cotton in the world, because its fiber is longer, stronger, and finer than the upland variety. It has black seeds, while the upland cotton has green ones. The upland cotton is raised in the states away from the gulf and is largely manufactured in our cotton mills.

Cotton-boll Weevil. The cotton-boll weevil attacks the buds and the seed pods of the cotton plant. It is a small gray beetle about a quarter of an inch long (Fig. 43). It spreads very rapidly and often destroys entire crops. The loss in Texas alone has been millions of dollars. The United States Government has spent a great deal of money fighting the boll weevil, besides what has been spent by the cotton states. It will feed and breed only in the cotton plant, but it lives through the cold season under the moss of trees and under rubbish.

Fighting the Weevil. Clean farming methods and early harvesting have been the ways recommended to fight the weevil. If the cotton is all harvested and the plants are destroyed by the middle of October, the weevil will die of starvation. Where this has been done, it was found that only three weevils out of a hundred lived through the winter. Cotton

stalks may be removed most effectively by uprooting, piling, and burning. Some cut them down with a stalk chopper, then plow deeply and harrow the field. Others turn in enough cattle to eat the green cotton in a few days. In addition to destroying cotton plants, all kinds of rubbish along ditches, fences, and field borders should be cleaned up so the weevil may have no winter shelter.

To Hasten the Crop. The use of fertilizer hastens the ripening of the cotton and makes it possible to harvest it in time to starve out the weevil. A failure of the cotton crop is a serious thing, because there is nothing to take its place. The Cotton Belt of the United States extends from the Carolinas to Texas and Oklahoma. Three-fourths of the cotton of the world is raised in this belt, and about ten million bales are yearly sent to Europe and the manufacturing parts of the United States.

CHAPTER XIX

THE HAY CROP

Timothy. One of the chief hay crops of America is timothy. It is grown chiefly in the northern part of our country east of the Rockies. Timothy is popular with farmers, because the seed is cheap and because it will produce a good hay crop the first year after it is planted (Fig. 82). It is easy to kill it by plowing. Timothy fits well into a system of rotation with other crops. It needs a good soil and plenty of rainfall. It is not only an excellent hay crop, but it is used in nearly all lands intended for pastures. After a few years other pasture grasses take its place.

The Clovers. Another hay crop is red clover. This plant, like so many others, came to us from Europe. It has been grown for many hundred years. Farmers have known for a long time that clover seemed to make the land richer, but they did not understand why this was so. We now know that clovers and their kin, such as alfalfa, cowpeas, and soy beans, enrich the soil through the work of the bacteria on their roots. We have learned that the bacteria take nitrogen from the air and store it in little swellings on the roots of these plants. When the sod is plowed for other crops, the nitrogen helps to produce much better yields (Fig. 53). These

clover-like plants are called legumes. They are valuable because of the hay and pasture they yield and because they help us to build up the land on which they grow, with plant food. Most crops leave the land poorer, but legumes leave it richer, at least in nitrogen.

Kind of Soil for Clover. Red clover requires a good soil. Many farms are too poor to grow it. The

FIG. 82. *Timothy hay.*

land should be well drained, because the roots will reach down five or six feet if the land is not swampy. Sometimes a sprinkling of lime to sweeten the soil will help a clover crop to thrive. This is true of some sections of eastern Ohio, southern Indiana, and Illinois.

Ready to Cut. Clover is usually sown in the spring on the winter wheat crop. It lives about two years. Clover grows two crops a year. The second

crop is often cut for seed. In order to obtain the best hay, clover should be harvested just after it has

FIG. 83. *A hand dump rake.*

come to full bloom. Hay cut later is not so good.

Careful Handling. In harvesting the clover crop, it should reach the barn or stack with the least handling and exposure. If it is allowed to become too dry in handling, the leaves will crumble and fall off, and they are the best part of the hay.

Curing Clover Hay. Clover hay should be well cured in the sun, or it will heat and spoil in the stack or mow. Some farmers cut it in the afternoon, and after the dew is off the next morning it is tedded, raked, and put in the cock before night (Figs. 83, 84, 85, and 86).

Uses of Clover. Red clover is used for hay and for pasture. It is often used as a green-manure crop to be plowed under if the ground is poor in humus. Even where it is cut for hay, the stubble and roots

turned with the plow show gains in the crops that follow, because of the extra amount of nitrogen left behind. Clover makes an ideal hay for cattle, and where it is raised, it should make up a half or more of the roughage of milch cows. Sheep and young stock make excellent growth on clover hay or the clover pasture.

Getting a Stand. Where the soil has been worn out by many crops being taken off and no plant food or humus put back, red clover will not often grow. In order to bring such land up, a heavy coat of barnyard manure will help to give clover a start. Another way to get a set of red clover on poor land is to

Fig. 84. *A self-dump hay rake.*

spread straw over the wheat or rye ground that has been seeded to clover. This is done in early spring, before the clover seed has begun to sprout.

Alsike Clover. Still another way to get one's poor fields seeded to red clover is to first sow Alsike clover. This will grow on soils that are too wet or too dry or too poor for red clover. Alsike is hardier and less likely to be attacked by disease.

Alfalfa. Another clover-like plant that is coming to be even more important than clover is alfalfa

Fig. 85. *Hay loader.*

(Fig. 87). It was brought to America in the early days by the Spaniards, but only in recent years has it become a widely grown crop in the United States. Like clover, it is a legume whose roots are homes for bacteria. Thus it both brings the farmer fine hay and pasture, and it enriches his fields at the same time. Alfalfa has for years been a leading crop in the West. It is now being introduced widely in the great Corn Belt. It is a fine feed for milch

cows and for fattening hogs, lambs, and cattle.

The Soil and Crops. Alfalfa has a long tap-root which reaches down deeper than any other farm crop, often being twelve feet long (Fig. 88). Thus, you see, alfalfa needs a well-drained soil. It thrives wonderfully in dry regions. It continues to grow throughout the warm season. In Canada they cut

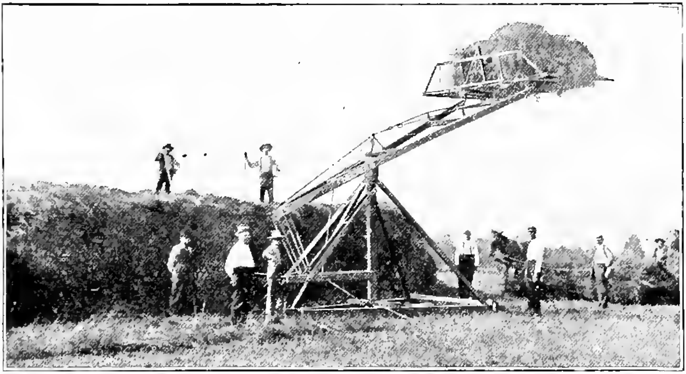


FIG. 86. *Horse power is cheaper than human labor.*

three crops of it in one season, while in Arizona eight cuttings are often harvested.

How to Start Alfalfa. Alfalfa is not a successful crop on poor land. If the land is not rich enough, a heavy coat of manure may be necessary. In many places east of the Mississippi River lime is needed to give alfalfa a start. About twenty-five pounds of seed are sown to the acre in the East, but much less is used in the West. It is best to sow alfalfa in the late summer or early fall. It is sometimes seeded

with grain in the spring. The field should be mellow and fine as a seed bed, for alfalfa is not a strong plant until it gets a good start. Weeds will injure it, so it is well to sow seed that is free from weed seeds. Alfalfa may be grown on the same field for a longer time without change than most crops, but it should be plowed in at intervals of from five to seven years and some other crop sown.

Good for Horses. There is no one thing so good as alfalfa for the working horse. It builds up his worn-out muscles and keeps him strong and healthy. He needs much less grain when he can have alfalfa hay. It ought to be free from dust, but it does not

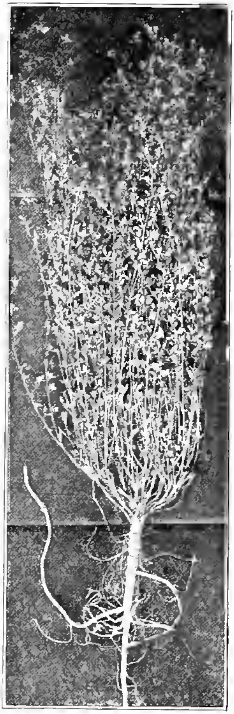
Courtesy of Santa Fe R. R.

FIG. 87. *A field of alfalfa—six crops to the season.*

gather dust so easily as clover. It is not safe to feed too much to horses.

Alfalfa for Other Stock. Milch cows thrive on alfalfa, and nothing better is grown for calves,

sheep, and hogs. Alfalfa and corn fed together make a finely balanced food for stock, because the food element that is lacking in corn is found in alfalfa; and what alfalfa lacks, corn will supply. Not only is alfalfa the best forage food for stock, but it will do more even than clover to build up the soil. Its roots go down very deep, and thus it gets food where no other farm crop can.



Courtesy Santa Fe R. R.

FIG. 88. *Alfalfa plant showing long tap-root.*

The Cowpea. The cowpea is another legume and is a cousin to the clover and alfalfa. It has come to be an important hay crop in our Southern states, for it likes warm climates. It will grow on almost any kind of soil that is not too wet. Like clover, the cowpea will make good hay or green feed, and it enriches the soil.

The cowpea is an annual plant and resembles the bean. Some varieties are bush-like while others are trailing. As it is difficult to cure without losing the leaves, it is sometimes grown with German millet to help save the leaves and to assist in speedy curing.

CHAPTER XX

ORCHARDS

Helping One Another. Fruit trees of some kind will thrive in any section of our country, so every farm should have its own fruit. Some farmers make fruit-raising their chief business, while others have only a small orchard for family use. If the raising of fruit is the principal object of the farmer, he should locate where many other farmers are doing the same thing, so that they may form companies to help one another in many ways, especially in obtaining good prices for their crops.

Keep Near Market or Railroad. It is well not to go too far from the railroad to raise fruit. When peaches are to be handled, they should not be hauled more than three miles. Strawberries must also be marketed soon after they are picked and with as little cartage as possible. Apples are more firm and will endure more handling, but the expense of a long haul reduces the profits.

Hill Lands for Orchards. It is usually better for orchards to be upon land higher than the rest of the farm. The cold air is heavier and settles into the valleys and lowlands, so the hill orchards are not so likely to be caught by late spring frosts.

The Best Slope. The north and east slopes of hills are preferred for apple orchards, because they

are slower in warming up in the spring. This keeps the blossoms from coming out too soon and being injured by late frosts. Trees set on southern slopes receive more sunshine, and their fruit is more highly colored. But southern slopes are usually drier than northern slopes, and thus the fruit does not grow so large.

The Influence of Water. Land sloping toward a river or a large body of water is good fruit land, because the water keeps the air from too sudden changes. The fruit should be on the slope that receives the wind after it has crossed the water. Air near water is kept from getting suddenly colder and there is less likelihood of frosts. (Fig. 89.)

Kinds of Soil for Fruits. For apple, pear, and plum trees a farmer should choose a deep, moist, clay loam. A sandy loam is better for peaches aud cherries.

Preparation of Fruit Land. The soil should be prepared as carefully for a fruit orchard as for corn. It is plowed deep for planting the trees, so the roots may reach out far and wide for food. The surface should be harrowed to a dust mulch. If the field is wet and swampy, it must be drained.

Planting Trees. The trees may be planted either in the spring or fall. If the soil is in good shape, fall planting is better, because the trees get a start before winter. To make tillage easy the rows should be straight. Apple trees are commonly planted forty feet apart each way, but sometimes they are planted

closer. Pears are set about twenty-five feet apart and peaches and plums each twenty feet. There should always be room enough between the trees so spraying may be easily done and the crop harvested conveniently.

FIG. 89. *Irrigating an orchard.*

Setting Trees. When a tree is taken from the ground the more roots that are saved the better. But with the best of care many of them are broken or bruised, and others must be cut. All the broken roots should be cut back from the injured end with a sharp knife, so the smooth wound will heal quickly. Since the tree has lost many of the rootlets that supply it with food, the branches must be cut back, too, else they will need more food and moisture than the roots can supply. People usually leave too much of the top on a tree that is transplanted. The trees should not be exposed to the sun and wind before planting, and the planter should not allow the roots to dry out. If the roots are covered with a coat of clay, it is well to dip them in water before setting them.

Packing About the Roots. The holes dug for the trees should be a little larger than the roots seem to need, so that they can be placed straight. Since the roots feed the tree, it is very important to pack the soil well about them, so they can get plenty of liquid food from it. The upper roots should be raised until the soil is packed firmly under them. Roots should never be crowded together, but spread out naturally to grow as they will. In the bottom of the hole the soil must be packed very tight, but the top four inches should be loose for a dust mulch. A common mistake is to pack the soil tightly on top and leave it loose underneath. This brings the moisture to the surface and causes the young trees to die of thirst.

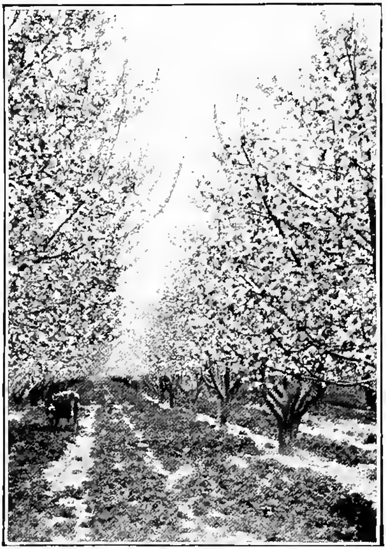


FIG. 90. *A crop between rows.*

Tilling the Orchard. The old idea that orchards would take care of themselves after planting is a thing of the past. Now the successful fruit growers till their orchards as regularly as they do their crops. Trees make nearly all their growth early in

the year, before the hot months of midsummer, so it is during the spring months that they need plenty of food and moisture. Then is the time to cultivate the orchards. More than nine-tenths of the fruit is water, and we know that tillage is very helpful in saving moisture. The drier the season, the more the harrow and cultivator are needed. After July, when the growing period is over, a crop may be sown on the orchard to be plowed under later as green manure (Fig. 90).

Injury to Trees. In tilling orchards, care must be taken not to injure the trees. The grass and weeds that grow close to the trunk of the tree do very little harm, and they had better be let alone, rather than run the risk of injuring the tender bark of the young tree.

Pruning. If young trees are well pruned when they are set out, they will need very little more trimming until they begin to bear. Shoots that cross each other and interfere with other branches should be removed. When branches are likely to become too crowded, the knife should be used. Many fruit growers change the shape of their trees to their fancy by pruning. They cut the tops back so the trees will spread out instead of growing tall, for it is difficult to spray a tall tree, and the fruit is harder to gather.

Spraying Fruit Trees. All fruit trees have enemies which the farmer must fight. More than twenty-five years ago a man who was employed by

the state of Illinois to study plants, discovered that Paris green would kill the potato beetle. He said that he believed the same poison would stop the cankerworm from injuring the apple crops. For a good many years farmers doubted and shook their heads; but here and there a man began to spray with Paris Green to protect the crops, and they found it worked well. Fewer apples were found wormy in orchards that had been sprayed. (Figs. 38 and 39.) This was only the beginning of an intelligent fight to protect crops and trees from insects. Many discoveries have been made since, and now the best farmers everywhere are spraying with different mixtures to save their trees and fruits, their gardens and other crops. In the West, where the finest of fruit is raised, state laws have been passed, commanding every orchardist to spray his trees whether he finds them troubled with insects or not. This is to make sure he will not grow millions of insects to attack the orchards and crop of some neighboring fruit grower who is careful in spraying.

Bordeaux Mixture. Besides the insects which injure our trees, there are tiny robber plants, or fungi, like mildew and the brownrot, that attack peaches and other stone fruits, sometimes even apples and pears. In France, where many grapes are raised to make wine, the grape farmers near Bordeaux found that their vines were being injured by mildew. So they set very earnestly to work to find a check for

this enemy. After much experimenting, they discovered a poison spray now called the Bordeaux mixture. It is used all over the world to-day to kill the fungi that are injuring gardens and orchards.

Spraying Machines. A farmer who has not more than five acres in his orchard can use a spraying machine worked by hand. There are many kinds of good spraying outfits. (Fig. 91.) It is chiefly important to be sure that the liquid is well stirred by some means, so that the poisons will not settle to the bottom of the barrel instead of reaching the tree. The best fruit growers spray their trees regularly. (Fig. 92.) Peaches and prunes are usually not sprayed unless they are attacked by the scale. In many places apples are sprayed three times—once just before the blossoms open, again just before the blossoms fall, and a third time about ten or twelve days later. The mixture used is three or four pounds of copper sulphate, five pounds of lime, and a half pound of Paris green in fifty gallons of water.

Thinning Fruit. Some fruit growers are now urging the thinning of the fruit crop. A part of the fruit on heavily-loaded trees is taken off before it is half grown, so that which is left may grow to a larger size. Though it costs a good deal to thin, the growers argue that it costs no more to pick the fruit when small than when it is full grown; and the fruit that is left to ripen is so much larger and brings so much better prices that it is well worth

while. In Western regions the trees bear such heavy loads that the branches break unless some of the fruit is removed. When the crop is light there is no need of thinning. Apples usually grow in clusters from three to a half dozen in a bunch. If one

FIG. 91. *A good spraying outfit for the orchard.*

is growing fancy fruit he should remove all but the best apple of each cluster. Pears grow like apples and may be thinned in the same way. In thinning stone fruits, the work may be done by pulling the fruit off; but with apples and pears it

is safest to clip them with sharp-pointed shears, because pulling is apt to break the branch. A fruit tree that has been properly pruned and the crop thinned, will not need props to keep it from breaking down; and it is more likely to bear a good crop every year.

Harvesting Fruit. A farmer who grows fruit for market must pick it carefully to prevent bruising. In order to make the fruit attractive to the buyer, the grower grades his apples, that is, he sorts out those of the same size and packs them together. Boxes are being used for packing, though many still prefer barrels for apples. Neat and careful packing helps to secure good prices for the fruit crop.

Peaches. Though many peaches are raised in California, the greater part of them come from the Eastern states. A mildly temperate climate favors this fruit. They must be packed quickly and closely and sent by fast freight when shipped. Packers get two cents a basket, and an expert packer can fill a hundred baskets in a day.

Apples. Of all the many fruits grown in our country, the apple is the most important. More than forty million barrels are used every year, or about a half barrel for every man, woman, and child in the United States. There are fewer difficulties to meet in raising apples than any other fruit. The tree is hardy and is not easily injured. There are many varieties of apples that keep well through

the winter. All kinds are firm and can be handled and marketed with less care and trouble than other fruits. Apples may be put to many uses. They are eaten raw or they may be cooked in a variety of ways. Some are dried or made into jelly, and in this form they may be kept for a long time.

Seedless Apples. Since we have varieties of seedless oranges, men have been trying to develop an

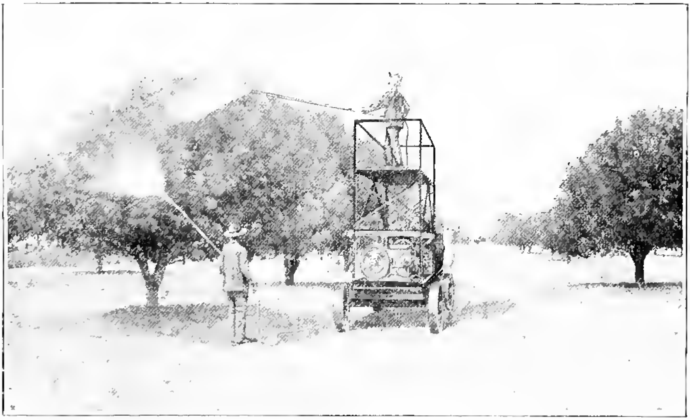


FIG. 92. *The successful orchardist always sprays.*

apple without a core. When this kind takes the place of those we now use it will be a splendid thing for us all, because there are certain insects that live in the core of the apple and there is so much waste in removing it. Some day seedless apples will be a very common thing.

CHAPTER XXI

SUGARS AND OTHER CROPS

Where We Get Our Sweets. Each person in the United States eats, on an average, more than seventy pounds of sugar in a year. Sugar is made from the sugar cane, the sugar beet, and the sap of maple trees.

Sugar Cane. Sugar cane may be grown in the Southern states wherever cotton is found. It very much resembles corn in appearance. Cultivated cane never produces seed, so the new crop must be grown from cuttings of the stalk. It takes a ninth part of the old crop to plant the field for a new one. The seed cane is usually stored on the land in the fall and covered with a layer of leaves and a thin layer of earth to protect it from the frost. In the spring it is uncovered or "hooked up" with long hoes and cut into pieces two feet long.

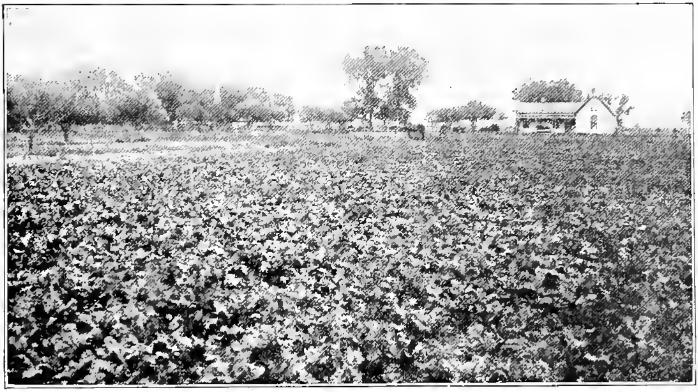
Planting. The land is plowed and thrown into ridges eight feet apart, and the seed stalks are laid end to end in double rows in a trench on top of the ridges. An extra piece of cane is put near each joint so the sprouts will be regular. Cane should send up a sprout at every joint. Covering is done with a hoe or a machine. A machine covers ten acres in a day. The first crop is known as plant cane. The next year it will spring up from the same

roots, or it may be planted again. A good crop will come from the stubble even the third year. The land is then plowed and sowed to cowpeas. The fourth year a new crop of cane may be raised on the land where the cowpeas have been plowed under. Cane sometimes grows fifteen feet high.

Harvesting. Harvesting begins in October. The sugar forms most rapidly then, but the crop must be cut before the frosts injure it. Colored workmen using a long knife go through the fields cutting the stalks very close to the ground, for the lower ends yield the most sugar. The leaves and tops are trimmed off, and the stalks are laid in piles. At the factory the stalks are cut and shredded into small pieces, and the juice is crushed out between heavy rollers. This juice is put into large tanks with milk of lime to be made clear. Then it is made into syrup, and the molasses is separated from the sugar, which is then dried into large crystals and refined into our white sugar.

Sugar Beet. It is impossible to tell by taste whether the refined sugar is made from cane or from sugar beets, but the raw beet sugar has a disagreeable odor and taste. Beet sugar was not discovered by accident. It was made after years of experimenting. More than two hundred years ago a German druggist first found sugar in beets, and sugar being at that time a dollar a pound, Napoleon offered a prize to any one who could make sugar from beets. The art was soon discovered, but it is

only within a short time that beet sugar has been made in the United States. The soil and climate of the greater part of our country will raise the sugar beet. The labor required to produce beets is much



Courtesy of Santa Fe R. R.

FIG. 93. *A field of sugar beets.*

more than that required for an equal crop of corn, wheat, or potatoes; but the income is much greater.

Preparation and Soil. The land for sugar beets must be a rich, deep soil. Plenty of moisture is needed while the plants are growing, and dry, warm weather when ripening. If sugar beets are to follow a grain crop, the land should be plowed lightly as soon as the grain is harvested. The ground is then dressed with a coat of manure, and later in the season it is plowed deep. The subsoiling plow that loosens the earth to a depth from fourteen to eighteen inches, enables beets to reach down into the

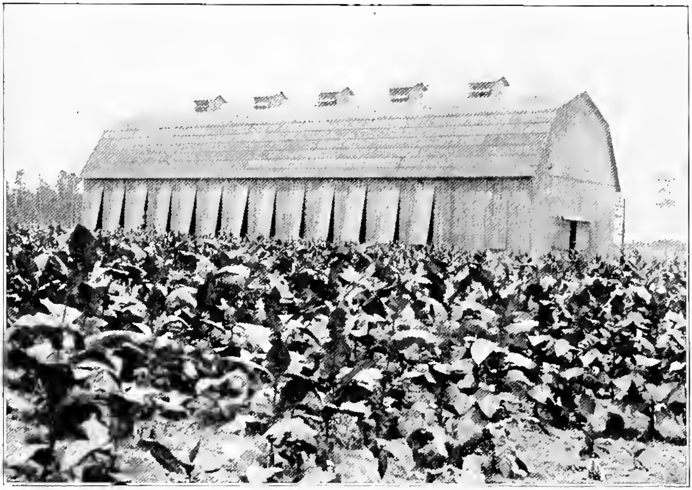
soil where they will receive plenty of moisture at all seasons. Before planting, the ground is dragged or harrowed and rolled to pack it firmly. The beets are planted with machines. Horse-power machines plant four rows at a time. Since the sugar beet needs about four or five months' time to grow to the full size, it should be planted two or three weeks before corn. (Fig. 93.)

Harvesting. In October the farmer takes a few beets to the factory to be tested for the amount and quality of juice. As beets increase in weight rapidly the last six weeks, it is well to delay harvesting as long as is safe to avoid danger from frost. The beets may be plowed loose eight or ten days before removing from the ground. They are then pulled by hand and the top cut off close to the root to remove the matter that prevents the separating of the sugar from the juice. The beets are then sent to the factory. Europe produces larger crops of sugar beets than any other part of the world.

Rice. Rice furnishes the principal food of half the human race. It first came from the East Indies, but is now raised in many parts of the earth. It was probably brought to America when the Carolinas were settled, and it is now the staple product of South Carolina. There are two kinds of rice, the upland rice and the lowland rice. Lowland rice was first grown in places that were overflowed by the tides, but irrigation is now used to raise this variety in most of the Southern states. Upland rice does

not need to be flooded, but is cultivated much as oats or wheat.

Growing Rice. The ground is prepared for rice and the seed is planted, harvested, and threshed very much the same as wheat. Where the rice crop



Courtesy of the Alabama Tobacco Company

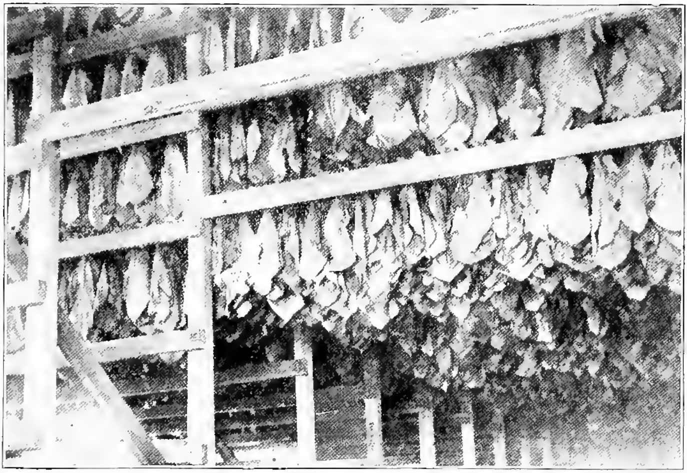
FIG. 94. *A heavy crop of tobacco and drying barn.*

is flooded with water, the ground is allowed to dry out at harvest time. The upland rice is thought by some planters to be better than the lowland variety, but the yield is not so great.

Rice Products and Enemies. From the thresher, the rice is sent to the mill in barrels. A little more than half of it comes out clean rice, a small part is polish, and about a third is bran and waste. The

rice polish and bran are mixed and sold to feed pigs. The rice-stalk borer, the chinch bug, and the "black weevil" are all enemies of the rice crop.

Tobacco. The United States produces more tobacco than any other country in the world and sends



Courtesy of the Alabama Tobacco Company

FIG. 95. *Drying and curing tobacco in a well-ventilated barn.*

more than one-third of it to other lands. The variety of tobacco raised depends upon the soil, climate, and the use it is to be put to. (Fig. 94.)

Wet soils of clay produce large, heavy plants that cure to a dark brown or red. Light, sandy soils raise a thin leaf curing to a bright red, mahogany, or yellow color. The quality of tobacco is affected by the soil, kind of manure used, and the climate,

more than almost any other plant. In the northern regions the seed is sown in a hotbed protected by cheesecloth. The young plants are tender and need watering with a weak manure water. They should be transplanted when five or six weeks old. They may be well cultivated until the plant begins to bud; then, if no seed is desired, the plants are topped so the strength may all go to the leaves.

Fertilizer. Barnyard manure produces a rank growth of tobacco, but it is poor in quality. Potash is the most important plant food for tobacco. Nitrogen is supplied in cotton-seed meal.

Curing. When the leaves begin to turn yellow, the stalks are cut close to the ground. They should

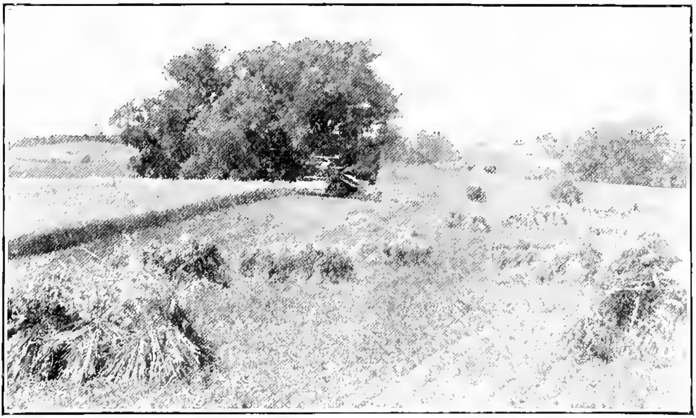


FIG. 96. *A heavy crop of oats.*

be wilted by cutting them when the sun shines the hottest. The plants are then hung up in the drying

house without being crowded together. (Fig. 95.) After drying, the leaves are removed and tied up in bundles called hands. The tobacco leaf loses more than three-fourths of its weight in curing. Tobacco is made into cigars, cigarettes, cheroots, and snuff.

Oats, Barley, Rye, and Buckwheat. Other grains fit for temperate climates are oats, barley, rye, and buckwheat. All are sown much like wheat. Oats grow on light or heavy soils, but do not like too much water. (Fig. 96.) In the Western states oats are frequently sown on corn lands without plowing and are covered with a disk harrow. The varieties that mature early escape the rust. These plants furnish green forage, hay, and straw, while the grain products are food for both man and beast.

CHAPTER XXII

THE FARM GARDEN

The Boy's Garden. The garden is a chance for the farmer boys and girls to have a little farm of their own. It is impossible for every child to have much space in the school garden (Fig. 97), but at home he should have a little plot of ground to raise his crops. Here he can plant what he likes and learn many important lessons about how to till the soil and to care for plants. Any boy likes to try experiments for himself and to feel that there is one spot where he is the "boss." Whatever is raised in the child's garden should be his produce to sell or give away as he pleases.

A Good Story. The story is told of a certain farmer's boy who was anxious to leave the farm. He was tired of the salt meat and potatoes that were served at his father's table three times a day. One summer he went to work for a neighbor. Here they had plenty of delicious sweet corn, tender young beets, sliced, ripe tomatoes, and meaty Lima beans, with a juicy melon from the spring house for dessert. The boy went home, started a garden, and decided to stay on the farm. (Fig. 98.)

Gardens Everywhere. It is surprising how many garden crops can be grown in every part of the United States. In the cooler climates, garden truck

grows rapidly because of plenty of moisture. In Dakota the best place for a garden is where some large snowdrift has melted late in the spring. In Texas vegetables grow the year around. Different

FIG. 97. *A school garden.*

varieties belong to different sections of the country, so seeds should be selected that have been tested and do well in the region where they are to be planted.

Location and Soil. Since the garden belongs to the kitchen, it should be as near it as possible. Almost any soil can be graded, manured, and drained into a good garden, unless it is a very stiff clay that will not admit draining. The best garden

soil is a sandy loam that will dry out quickly after rains, so that it may be cultivated often.

Fertilizing. Plowing in the spring must be done as soon as the ground will permit, but it is better to plow the garden in the fall so that freezing will crumble the ground into fine particles. Garden plants are grown close together in a small space, and we want them to grow quickly, so they need a great deal of plant food. A thick dressing of stable manure, from five to ten loads to an acre, should be put on before the second plowing. If this garden manure is hauled in the fall and made into a long, narrow heap mixed with sods and forest leaves, it will be well rotted and fine by spring; and it will easily mix through the soil, giving every inch of ground its portion. Leaves from the lawn should always be piled on the garden to decay.

Well-rotted manure supplies all the nitrogen a garden requires, but to give vegetables a good flavor, potash is needed. Wood ashes will furnish this. After the manure is plowed under, the ashes are sifted on top, and then the surface is harrowed until all is fine as an ash heap. Dried hen manure, pounded fine and sifted, is often harrowed in with the ashes and is especially good for some garden crops.

Preparation. The garden should be plowed from six to eight inches deep and harrowed four or five times. All stones must be removed. If these can be buried so as to be beneath the reach of the plow,

FIG. 98. *A boy's garden—Beautiful as well as profitable.*

they will help to drain certain wet spots in the garden. A hand roller and hand rake are used for pulverizing and crushing lumps of earth left by the harrow. For root crops in clay, a subsoil plow that drags a second share after the first and breaks and loosens the bottom of the furrow to a great depth is often used.

Garden Tools. Small hand tools, such as trowels, spuds, and dibbles, are used in transplanting. The hoe and steel garden rake are useful in finishing the top of the ground. The common hoe is too wide for narrow rows and delicate plants, so there are

many different sorts of blades made. Markers for keeping rows straight and a small hand roller, are great helps. The wheel hoe is the best cultivator. Every farmer should have blades of different sizes and a set of disks which can be used on the cultivator.

Mulch. We know that a covering of fine, dry earth, or a dust mulch, prevents moisture from escaping from the ground. "A finely raked garden bed is dry on top, but the footprints of the cat remain moist for days, because the animal packed the soil wherever it stepped, and the water climbed up from one grain of earth to another until it reached the surface." Besides convenience in cultivating, it is wise to plant seeds in rows, instead of in beds which have been raised or hilled up, with high beds and low places between. When we leave the ground rough, or make large holes around our garden plants, we leave more soil exposed to the air, and this helps moisture to escape from the ground. In a very wet season, it is well to hill up crops like potatoes or corn, because we then wish to get rid of part of the moisture.

Planting. We are usually told to make the earth firm and well packed over newly-planted seeds, because this brings moisture to the seeds lying near the surface and so hastens the sprouting. As soon as the seeds have sprouted, the ground should be loosened to stop evaporation. Large seeds can be planted deep and the earth well packed over them,

then the top is raked. To water a bed, wet it thoroughly in the evening. When the morning sun begins to dry it out, loosen the top earth to stop the rise of moisture. Sprinkling the plants every few days is very harmful. Do not sow small, slow-sprouting seeds like celery and onions in land that bakes. A layer of chaff or a board may be laid on the row to hold moisture, but it must be gradually lifted as soon as the seeds get a start.

Transplanting. In thickly-sown seed beds one must thin or move the plants to the garden as soon as they have their first true leaves. While seeds of lettuce, onions, radishes, peas, and many other things, can be sown in the ground in the early spring, we can gain from four to six weeks by sowing the seeds of others indoors and transplanting them. Many farmers buy their egg plants, tomatoes, cauliflower, and peppers from hothouse gardens; while others grow their own in window boxes, hotbeds, and cold frames.

The Window Box. A window box fifteen inches square and six inches deep, or old tin pans nearly filled with soil, are put in a south or east window. Suitable soil or dirt has been obtained in the fall and stored in the cellar or some convenient place. This is mixed with a little coal ashes or fine sand to make it light and loamy. The seed is scattered and covered lightly. The soil is then watered with a fine sprinkler. Squashes and cucumbers may be planted on pieces of sod turned upside down. These

sods can be set into the ground as soon as the soil can be worked.

Hotbeds. Hotbeds are box-like frames sunk in the ground and covered with a sash filled in with glass or cloth. Some of the soil in the frame is taken out, and horse manure is put in its place. When packed solidly in the pit, the manure rots and produces heat. Over the manure is three or four inches of fine garden soil in which the seeds are planted. The manure keeps the soil above it warm. Hot air or hot water pipes are sometimes used under the hotbeds instead of manure. A well-drained spot, sheltered from the cold winds and sloping to the south, is best, because the sunshine is very helpful. It takes care and judgment to handle a hotbed properly, because plants must be aired and watered at proper times.

Cold Frames. The cold frame is like the hotbed, but has no manure in it and therefore no bottom heat. A combination hotbed and cold frame may be made of a large drygoods box partly filled with horse manure well trampled down and covered with clean straw. Small, shallow boxes are nearly filled with soil. After the seed has been planted in them, they are placed on the top of the manure and covered with a pane of glass. Thus each box becomes a little hotbed. The glass is removed now and then for air. If the manure becomes too warm, the small boxes are raised on bricks. When the heat of the manure is gone, the hotbed becomes a cold frame.

Preparing for Transplanting. When the ground out of doors gets ready for transplanting, the plants in the window boxes may gradually become used to the colder air by having the window raised a little at a time. The hotbed sash is left open on bright, sunny days until the plants are ready for living in the open air.

Transplanting. In transplanting, one must handle plants gently and plant them in freshly-turned soil which is very fine. A hole is made with a dibble or trowel. Put a cupful of water in each hole, and press the earth firmly about the roots. Roots of plants are often broken off in transplanting. Except with tomatoes and eggplants, part of the leaves may be cut off so the roots will not have too much top to feed until they get a firm hold. If the soil is freshly turned and the transplanting is well done, it is not necessary to water plants. If late in the season the gardener may transplant on a rainy or cloudy day. A handful of grass or hay packed around plants that have just been set out is better than covering with tin cans or flower pots, for they need light and air to breathe.

Rotating or Changing Crops. Every vegetable has its own insect enemies and diseases. If the same vegetables are raised year after year on the same soil, these insects and diseases will grow worse. The vegetable also uses up some of the particular plant foods that it needs. Some plants are surface feeders, the roots not growing deep. Beets, carrots,

and potatoes grow deeper and are able to feed where the others could not. If vine crops are followed with root crops, the latter will do well by feeding below where the others did. Radishes, early lettuce, spinach, or peas may be harvested early, and cabbage, beets, or late sweet corn planted in their places.

Planting Between Rows. Planting between rows sometimes works well. In late June, when potato vines are well started, and the rows are well cleaned, late sweet corn is often planted between. However, if the season is too dry, this may injure both crops. Sowing turnips broadcast in late sweet corn or among tomatoes and squash, is worth trying.

Weeds. Weeds take moisture and plant food out of the soil, and they spoil the shape of many vegetables by crowding in upon them as they grow. They should not be allowed to reach the second leaf. In hand weeding it is well to collect the weeds in a basket. They sometimes take root again when left on the mellow garden soils. When weeds get a start, it is a good plan to cut off the tops with a sickle before seed forms on them. Mulching between the rows with a layer of straw prevents weeds from growing.

Mulching. In a dry season, after plants have been cultivated a few times and are well above ground, hay or straw about four inches deep may be put between the rows. This saves the labor of weeding and keeps the soil moist and cool. It is

especially good for potatoes, tomatoes, cabbage, beans, or vine plants, though in a wet season straw holds too much moisture.

Peas. Peas are the first product of real food value of the early garden. They are both delicious in flavor and very nourishing. By sowing the seed about a week apart, and using different varieties, one may harvest peas all summer. But the late varieties are in danger of mildew. Peas grow best in a cool climate, in a light, moderately rich soil. The first plantings should be in as soon as the ground can be worked. The soil must be kept mellow and free from weeds to raise good peas. They need not be staked with brush when the garden is worked with a horse cultivator. Where the brush is used they may be sowed in double rows. There are a great variety of peas, and those that have been tested in your region should be planted. Peas are injured by mildew and the pea weevil. The weevil may be killed in the seed by placing them, before planting, in a closed vessel containing carbon-bisulphide.

Beans. String beans should be sown as soon as the ground is free from frost, and every two weeks afterward to keep a supply for the summer. A sandy soil and a southern slope are best for beans, because they are tender and easily frosted. They should be planted less than two inches deep, for the growing top of the little plant is liable to be torn off as it comes through the ground. When

beans are to be used green, they must be picked frequently, for if the pods are allowed to ripen, the plants will stop producing. The bean weevil is a serious enemy and should be treated like the pea weevil. Lima and butter beans are best grown in Southern climates. Poles or stakes for these should be set at least four feet apart each way for their vines to climb on. The worst disease of string beans is the brownish or reddish pitted spots upon the pods; they spoil the appearance of the crop and cut down the yield.

Beets. The root crops all need a loose, deep soil. Subsoiling or double plowing is useful in hard earth. Beets are grown in rows three and a half feet apart. They may be sown very early, for the young plants will endure a light frost. They should be thinned when the plants are just big enough for greens. For winter beets, seed may be sown in July or August in the central states. After the first heavy frost, the gardener should take up the roots, cut off the tops, and store the beets in a root cellar or pit. Leaf-blight is common with the beet in some places. This is prevented by spraying with the Bordeaux mixture.

Turnips. Turnips should be planted on a rainy day and the seed covered lightly. About three-quarters of an ounce of seed to a row one hundred feet long. Young plants are thinned from five to seven inches in the row. If the plant grows too slowly, it is stringy and bitter. The fall and winter

crops of turnips are sown in July, after the early garden crops are harvested. The white and yellow varieties are equally good, except that the white turnip keeps best through the winter. Except the maggot, the turnip has no insect enemies.

Carrots. Carrots are good for soups, salads, stews, and other savory dishes. Carrot seed sprouts slowly, so it should not be sown deep. The earth must be kept loose. Radish seed sown in the same row will break the earth crust, and show where to expect the row of the carrots to appear. If seed is sown several times, a week or two apart, there will always be some carrots on hand. The plant has no serious insect enemies.

Parsnips and Salsify. Parsnips may be treated exactly like the carrot. Parsnips and salsify may be left in the ground all winter without protection, and they make delicious fresh vegetables as soon as the ground thaws. Salsify, or vegetable oyster, should be sown very early in the spring and the plants should not be crowded.

Radishes. Radishes need a mellow, quick soil. They do not thrive in clay. To be tender they must grow rapidly and should be eaten while small. Grubs burrow into the roots and make them wormy, if the same piece of ground is used every year.

Horse-radish. Horse-radish is grown from small roots that are trimmed from large ones when the crop is stored in the fall. These sets are planted two or three inches deep, top side up, and from

fifteen to eighteen inches apart in fairly wide rows.

Swiss Chard. Swiss chard provides "greens" all through the season. Only one sowing need be made. The chard is cultivated the same as the beet and thinned to twelve inches. If, when the outer leaves are as large as your hand, they are stripped off, a new supply of tender ones will keep coming.

Asparagus. Asparagus is a hardy plant. Its seed may be sown either early in the spring or late in the fall. When the roots are a year old, they should be transplanted in rows five feet apart, away from roots of trees or other plants. As much stable manure as can be plowed under, plowing ten to twelve inches deep, should be put on. Dig a trench nine or ten inches deep, and lay the roots about two feet apart in the bottom, covering them two inches deep with loose soil. The young roots that come up from the seed every summer should be weeded out. If the seed balls are cut off before they turn red, the plants can be kept from self-sowing. When the stalks begin coming up in the spring, the ground may be mulched with manure. This will save hoeing and also feed the roots.

Sweet Corn. If good seed is planted, it will produce a tender, sugary ear of sweet corn. Corn varieties mix so easily that only the most careful selection of kernels can improve a strain of corn. If the first lot is planted early in April, it will ripen the latter part of June in the latitude of New York. The corn should be planted thickly in drills with six or seven

kernels in a hill. If some should fail to sprout, there will be plenty left. If all seeds grow, it is easy to thin them. Be sure that there are not lumps or stones over the corn. The plant cannot fight its way out like beans and pumpkins. After the corn

FIG. 99. *A well-cultivated cabbage lot.*

is up, a handful of wood ashes on each hill will "make it jump." Break the crust after rains, keep the weeds and suckers down, and cultivate between the rows. For a continuous crop, plant every ten or twelve days until the latter part of July.

Cabbage. Cabbages need a moist, deep, well-drained soil. They thrive better in a spot where

cabbage, turnips, or mustard have not been grown for three years. Select good seed, and sow in a hot-bed or window box. When the plants are in the fourth leaf, thin them to secure stocky plants, and transplant only the best roots. When transplanting, remove the upper part of the leaves, set the plants firmly, and stir the surface soil. To stop the heads from bursting as they form, one may loosen the roots by slightly lifting and twisting the plant. Whitish butterflies lay their eggs on cabbages. These hatch green worms that eat the leaves. Kill the worms and spray with Paris green and water, or sprinkle with salt, lime, wood ashes, or pepper. The cabbage maggot works at the stem or root and causes decay. A piece of tarred paper put around the stem on the ground drives away the moth that lays the eggs. (Fig. 99.)

Lettuce. Lettuce is the most widely-grown salad vegetable. It is now ready for the table every month in the year. Winter and early spring crops are grown in cold frames. Seed for an early spring crop may be sowed in a cold frame in March. Sowings in the garden can be made from April to October. The cabbage varieties, or head lettuce, are blanched by tying the tops together.

Cucumbers, Melons, and Squashes. The seeds of cucumbers, melons, and squashes should be planted in shallow hills, three or four in a hill. They are all tender to frost. If each hill is covered with a box frame, it can be raised on warm days and taken

away when frost is past. The cucumber beetle and the "stink bug" are the chief enemies of these plants. Ashes, lime, and tobacco dust are used to drive them away. Muskmelons grow in warm, sandy land. Soil and location affect them greatly.

Onions. Onions are grown from seed or sets in the open ground or in hotbeds. If sown outside, the seed should be put in as early as possible in shallow rows three feet apart and covered with a half-inch of fine, moist earth. They must be carefully weeded.

Tomatoes. Tomatoes grew first in the South, so they need long seasons to ripen. Now, by selecting the right variety, the tomato can be grown in nearly every section of the United States. The plant may be started under glass or in window boxes about March first. They should be put in a cold frame where light and air are admitted on sunny days, until the ground in the garden is warm. Tomato plants are set from two to four feet apart. They need moderate pruning and some simple means of holding the plant off the ground when the fruit is ripe. The varieties differ in color from pink and creamy and bright yellows to bright red.

Grapes. In order that grapes may ripen, they need a warm soil and a sunny exposure. A trellis is used for support. Ten feet between the vines is best for most kinds. The Concord grape is raised in New York and Ohio; the small Delaware, in Delaware, Maryland, and New Jersey; but if we wish to see great clusters of white grapes, we must go to

California. The largest grapevine of the world may there be seen. It covers half an acre.

Raisins are dried grapes. There is a raisin vineyard in southern California which covers five thousand acres. Vines are pruned every year and the grapes gathered from the new shoots. Five-sixths of the grapes in California are made into wine or grape juice, or they are pressed as raisins. The dried currants that we use are really dried grapes. Grapevines are the prey of downy mildew, when it is hot and dry—also of black rot. Vines that have been weakened by bearing too heavy crops are often attacked. Prunings and fallen leaves and fruit should be destroyed, and the vines sprayed with the Bordeaux mixture. The first spraying should be done in the spring before the growth starts, and this should be followed every three weeks through the summer. To protect grapes for home use from black rot, frost, and birds, the clusters may be covered with paper bags which are allowed to stay on until the fruit is ripe. The warmth induced by the bags makes the fruit ripen earlier and it is larger.

Raspberries and Blackberries. The raspberries and blackberries do well in cool soil kept moist by mulching, after the ground has been thoroughly prepared. The shoots of both raspberries and blackberries that are sent up one season, bear fruit and die the next season. Pinch back the new shoots when they are two or three feet tall. This hastens the throwing out of side shoots upon which fruit

will be borne the following year. As soon as freezing weather is over in the spring, these side shoots should be cut back from nine to twelve inches. When the crop is gathered the old canes or shoots should be removed, and new ones cut away, leaving four

FIG. 100. *Nothing so fine as home-grown strawberries.*

to five good canes to each hill. For red rust, one must pull the plant out of the ground and burn it. Spraying has a good effect in fighting off the diseases of the plants.

Strawberries. The strawberry thrives best on a strong sandy loam or a light clay loam. For most purposes the plants do well to grow in narrow,

matted rows. They should be set out in the spring as early as the ground can be worked, in rows three and one-half feet apart, with the plants from one to two feet apart in the row. Planting may be done with a trowel or dibble. One must take care to spread the roots as much as possible and to press the soil firmly about them, holding the plant so the bud will be just above the surface. As fast as runners form, they should be removed, so that the strength of the plant may be used in producing fruit. (Fig. 100.) During the first season, strawberries are worked often. Weeds must be kept down, and the surface soil should be loose and open. Just before the ground freezes, a thorough cultivation should be given. After the ground is frozen, the plants may be mulched to the depth of two inches with straw.

The second season should bring a good crop. The June bug is the most common enemy of the strawberry. (Fig. 42.) When sod land is used for the crop, cutworms are very troublesome.

Currants and Gooseberries. The currant and gooseberry bushes like a cool, moist soil, so they cannot be grown in the Southern states. For the first two years after planting, they need but little care in pruning, except to cut back the new shoots about one-half. If they are very thick it is well to remove the weaker ones. Mulching will help to keep the soil moist. To do away with the worm and mildew, spraying is necessary.

CHAPTER XXIII

COUNTRY ROADS

The Importance of Good Roads. Few boys and girls realize how important good roads are to the farmer. Well-made highways enable farmers to save much time in marketing produce, and time is money. Easy travel also saves the energy of the horses, which means economy of feed. When the roads are in order the farmer can use his team when the field work can not be done, and this reduces the idle time of the horses. If travel is easy, the farmer will go to market oftener, selling many odds and ends of farm produce that otherwise might be left to go to waste because of the time it would take to dispose of it to advantage. For these and other reasons a fine public road makes the farms along the way more valuable. (Fig. 101.)

Sociability Encouraged. Aside from the money gain to the farmer, good roads encourage his family to move about more and to enjoy themselves socially. They gain a great deal in this contact with their neighbors. They go oftener to church, to other social events, to lectures, and to the city.

Good Roads and Schools. The older children may go farther to school if the roads permit. Consolidated schools are thus made possible, and pupils may be transported at public expense some distance

to the larger centralized schools, which have so many advantages over the one-room rural school. More expert teachers may be had, a trained superintendent can be employed, the children are better graded and the larger classes create more enthusiasm in study and recitation. A teacher trained in the science of agriculture can be secured to take charge of that subject and of the school garden. Centralized schools, besides being better equipped in every way, may be managed more economically in one building which requires only one heating system and one janitor. And all this is possible only when the roads are kept in good condition.

City People Interested. City people also demand good country roads because the better the roads, the more easily they obtain country produce and the cheaper it is. City people are using the country roads more every year for pleasure-driving and for automobiles. It is said that automobiles, because of the high rate of speed at which they go, do more to wear out the roads than all the heavy teaming of the farmers. The suction of the swift-moving wheels picks up all the finer particles and scatters dust far and wide. Because of the ravage done by the city automobiles, it is unjust to expect the farmers to build and keep the roads in repair. Moreover, the cost of the produce that the farmer takes to market is of as much concern to the people in the city that consume it, as it is to the man who has it to sell.

Marketing Farm Produce. More than two hundred fifty million tons of freight are hauled from farms to the market or railway stations each year. Counting the labor of men and horses, the wear of

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 101. *A brick road raises the value of farm land.*

vehicles and harness, it costs on an average about twenty-three cents to move each one of these millions of tons one mile. Railroads haul a ton of freight for long distances for less than a cent a mile. The farmer's distance to market averages nine miles and so the cost of hauling a ton of farm produce to market averages two dollars and nine cents. Better

roads would permit larger loads to be hauled in the same time and lighter loads in much less time. (Fig. 102.)

The First Expert Road Builders. The Romans were the first to solve the problem of how to build good highways. The central government at Rome built all the roads and kept them up. They were made of stone by trained experts, and in so solid a manner that, though the surface has required repair from time to time, the stone foundations are as good to-day as when they were built two thousand years ago. They will be serviceable for centuries yet to come.

Roads Abroad and at Home. European countries commonly have fine roads because they are constructed by skilled engineers under government service. But most states in our country still have their roads in charge of county officers who are not skilled in road building and who serve only short terms, giving place to others less experienced than themselves. These county officers are perhaps good business men, but are not students of scientific road construction; consequently, although millions of dollars have been spent on American country roads, they are in the main a failure. (Fig. 103.)

Plantation Mud Pikes. The earliest American roads were built in Virginia and led from the plantations to the landings on the rivers. These were simply mud roads built by the plantation owners. Hogsheads of tobacco were fitted with a pair of

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 102. *A brick road needs but little care or repair and brings the market nearer.*

shafts for a horse and were thus rolled along these roads to the river landings by horse power. Supplies for the plantations were hauled homeward in rude carts.

Our Early Roads. Save the Cumberland road, our national Government has done very little road building. The task of constructing good highways through rough and hilly sections has been poorly done and at great expense. In the early days many long roads were made and paid for by private parties, who then made every one who wished to use

FIG. 103. *Every township should own a steam road roller.*

them pay a toll. There are now but few toll roads.

Working Out the Road Tax. There are two ways of paying road taxes used in different parts of our land. One way is for the farmer to take his team and work on the road long enough to pay for the tax levied against him. This method is a failure, for the farmers seldom know how to build good roads and care very little how they work so long as they put in their time and get back to their crops.

A Better Way. The other method is much more satisfactory. It is this: Each farmer pays his road tax in cash and the money is used to employ men who are practiced in road making. Sometimes a man is employed the year round to prevent the

roads from getting out of repair. "A stitch in time saves nine," and so it is with a shovelful of gravel. A man and a horse and cart kept busy at the gravel pit all through the year are worth many times more in securing good roads than all the "working out" of taxes.

The State's Part. Many people are now coming to see that the state ought to keep up at least the main roads as well as build them. This will insure the employment of road engineers, and it will be done in a more permanent manner.

Drainage. It is useless to build a road without first providing a dry roadbed. Standing water and the grinding of wagon wheels will soon reduce any

FIG. 104. *Grading and draining are essential to good roads.*

road to a quagmire. The first step towards making permanent roads is to provide permanent drainage by ditching and tiling where it is necessary. (Fig. 104.)

Grading. Next in importance to drainage comes grading. The narrower the roadbed the easier it is to keep in order, because water will not so readily collect in it, but roads must be wide enough for teams to pass. The surface should be slightly rounded to shed water quickly, and the ruts must be filled as soon as they appear. Here is where the care-taker gets in his best work by preventing deep ruts from forming and keeping the roadbed dry. (Fig. 105.)

Surfacing Clay Roads. After drainage and grading comes the surfacing of the road. On a clay road a fairly hard and inexpensive surface may be made by thoroughly mixing gravel with the clay. This packs well and makes a hard surface, so if the mixture is of sufficient thickness the road will bear heavy traffic.

Sand Roads. Sand roads may be greatly improved by surfacing with clay. Sand mixed with clay does not make so firm a roadbed as gravel and clay, but it makes a fairly good surface.

Loam Roads. There are tens of thousands of miles of loam roads in the Central West and these roads are almost bottomless in wet weather. Loam takes water like a sponge, and on such roads it is not an uncommon sight to see an empty wagon

mired and abandoned. Farmers are told not to work their fields when it is wet, because it will harden them and they will bake afterward. This is the very reason why loam roads should have the surface stirred when wet. Such working is called puddling. It brings the soil grains in closer contact, making a harder surface than before.

The Split-log Drag. The tool most useful for puddling is the split-log drag. The halves of the log are held on edge a few feet apart by rounds inserted like the rounds of a ladder. This drag used on muddy roads will smear or puddle the surface, making it tough and hard. By lengthening one chain and allowing the inner end of the drag to lag behind as it is drawn along, it fills up the ruts and works all loose material toward the middle of the road. This gives the surface a rounded shape for good drainage.

Other Aids to Good Roads. This drag is very useful on dry roads also. By riding on the outer or ditch-end of the drag and driving once on either side of the road, the ruts are filled and the center made higher. There should be a law requiring all heavy hauling to be done with wide-tire wagons only. Wide tires pack and harden the road like a roller, whereas narrow tires cut and injure the road surface.

Gravel and Shell Surfacing. Different kinds of materials are used in surfacing roads. When suitable gravel can be found it will make an excellent

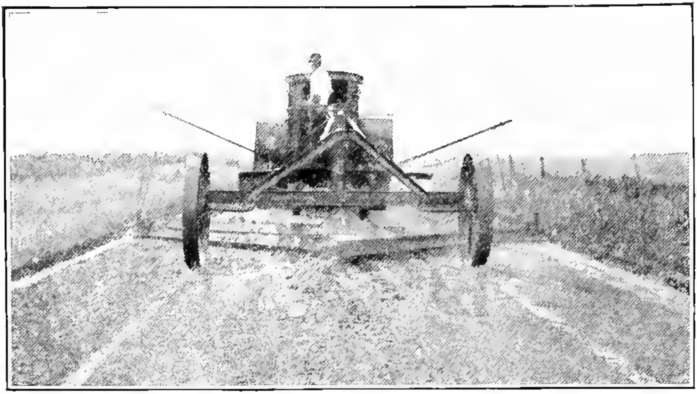


FIG. 105. *Grading a country road.*

road. In communities near the coast, shells from the sea are often used to surface roads and with excellent results.

Stone Roads. Probably the most popular material is broken stone. Stone-bedded roads are said to be macadamized, because a Scotch engineer named Macadam was the first to use and urge this kind of road.

Thick Roman Roads. The old Roman roads were surfaced with stone, which was often several feet thick and thus very expensive. Macadam believed that a smaller amount of stone could be made to serve just as well, and he urged that it would cost much less. The world has come to see the correctness of this plan, and now macadamized roads are found everywhere.

The Macadam Road. In order to build a macadam road, the roadbed is first given the slope desired, so the water will quickly flow to the side gutters. After this the bed is rolled hard with a heavy roller; then it is covered with a layer of coarse stone and rolled again. Then another layer of finer crushed rock is spread on top and rolled until it works in between the pieces of the coarser stone. A layer of still finer crushed stone or sand is next spread on and sprinkled with water, after which it is rolled until a smooth, hard surface is formed. Such roads are from six to twelve inches

Courtesy of the National Paving Brick Mfg. Ass'n, Cleveland, Ohio

FIG. 105. *Laying a brick road.*

thick. They cost from three thousand to six thousand dollars per mile, but intelligent farmers realize that such tax money is well invested.

Brick Roads. It is said that the best road material to resist the wear of automobiles is brick. Brick pavements cost considerably more than the macadamized road, but they are more satisfactory in many ways. They last longer, they require less repair, and they are not so dusty. In many places, as in Cleveland, Ohio, the brick pavements are being extended from the city limits to the county line, where the adjoining county is planning to take it up and extend the road to other cities. (Figs. 101, 102, 106.)

The Draft on Different Surfaces. How much a team can pull depends upon the firmness and smoothness of the roadbed and the grade. A load that three horses can just pull on level, hard asphalt, would require seven horses on smooth block pavement, fourteen horses on cobblestone, forty horses on an ordinary country earth road, and eighty on a sandy road.

Pulling Up Hill. The grade is also important. It has been found that if a horse can just pull a thousand pounds on a level road, he can draw only nine hundred pounds up a one per cent grade, eight hundred pounds up a two per cent grade, four hundred pounds up a five per cent grade, and only two hundred fifty pounds up a ten per cent grade. A one per cent grade is one that rises one foot in each hundred feet of distance, a two per cent grade rises two feet for each hundred feet, and so on. It is therefore much better to build the road around a hill than over it under most circumstances.

CHAPTER XXIV

PRESERVING FOODS

Germs which Help and Hinder. The farmer's wife has her problems of canning fruits and preserving foods. It is a help to her to know the enemies she must fight and the harm they do. There are three living organisms that will cause animal or vegetable matter to decay. These are yeast, molds, and germs, or bacteria.

The Yeast Plant. In order to grow, the yeast plant must have warmth, air, moisture, and sugar. This plant grows and divides into two plants, and these divide again and so on. Thus this tiny plant multiplies amazingly in a short time. It will grow in fruit juice and in fruit slightly sweetened, but it will not grow in thick sirups or preserves. It is easily killed by a high or low temperature.

Making Bread. A small amount of yeast is put in the dough to make it "rise" for bread. When sugar is added, the plants increase in great numbers in a few hours. They start the decay of the mixture and create a gas which forms bubbles throughout the mass, and these make the bread rise. When the bread is baked the yeast plant is killed by the heat, and the gas escapes.

Mold. Mold is spread about by tiny spores or seeds floating in the air. When they lodge on a

warm, moist surface, such as foods, they readily germinate and spread over the surface. Molds may be destroyed by heating to a high temperature for about twenty minutes. Canned and preserved fruits are more liable to be injured by yeast and mold than by bacteria.

Canning Fruit. The important things to remember in canning and preserving are to keep all cooking utensils clean and to kill all germs. This we call sterilizing. The kettles, jars, strainers, covers, rubbers, and other utensils used in canning, must be scalded to kill the germs, or bacteria. When all germs in the jars and fruit are killed, the cans are sealed while hot so as not to permit other germs from the air to enter. If live germs are left in canned fruit, a gas will escape which means that decay or decomposition has set in, and the food has begun to spoil. Foods and other organic matter will not decay if germs are kept out.

Bacteria. Bacteria multiply rapidly in meat, milk, and legumes. They cannot grow without the presence of water. Dried fruits and meats will keep because there is no water in which the germs may grow. Neither can bacteria live in a strong solution of common salt. That is why we salt meat to preserve it.

Smoking Meats. Meats are also preserved from germs by smoking. Smoking leaves a thin coat of creosote on the surface of the meat, which not only kills all germs but gives the meat a good flavor.

Certain kinds of wood smoke give the best flavor, though any wood may be used for the purpose.

Cold Storage. Putting foods in cold storage does not kill the bacteria, but it keeps them from growing and multiplying. As soon as the temperature rises, they begin to act and the food soon spoils.

Preserving Fruits. Sugar is used somewhat in curing meats and very extensively in preserving fruits. When fruits are cooked for a long time the "boiling down" kills all germs and drives off the water so that other germs can not grow.

Souring of Milk. It is also germs that cause milk to sour. The air contains many germs, the dust of the barn is full of them, and there are some on the milk pail and on the hands of the milker. So it is impossible to keep germs from milk. All milk cans should be scalded after using and, if possible, placed in the sunlight, which is a powerful enemy of germs.

Bacteria in Butter and Cider. Germs or bacteria make butter rancid. This can be prevented by working out of the butter all the milk and water which bacteria need to thrive and by thoroughly mixing salt into it. It is bacteria that makes cider turn sour and ferment. The solid, slimy mass known as the "mother of vinegar" is merely a vast colony of bacteria. Sweet cider makes the best vinegar because it contains more sugar for the bacteria to work upon. The process of makiug vinegar from new cider may be hastened by introducing some "mother of vinegar."

CHAPTER XXV

FARM SANITATION

Location of the Farmhouse. The farmhouse should, if possible, be located near the center of the farm so as to save the farmer's time in going to and from his fields. But the health of the family must have first consideration, and the home ought to be on high, well-drained ground away from marshes, swamps, and stagnant ponds. If the country is hilly, the south slope may be chosen for the house, because it is somewhat shielded from cold north winds and because the south slope affords more sunlight, which is the greatest friend of health and the greatest enemy of germs.

Dry Surroundings. The yard should be graded in such a manner as to turn all surface water away from the house, not only for health's sake, but for cleanliness, as mud and dampness about the house make the task of cleaning, fall heavily on the housewife. Farmers can easily learn to make cement walks to connect the house with the other farm buildings. Damp cellars cause mildew, and the decay of vegetables stored there sends a moldy, disagreeable odor over the whole house. The cellar should be light and ventilated by open windows, covered in summer by coarse netting to keep out flies and mosquitoes. The mosquito that carries the

malaria germ will breed in any damp corner of the cellar unless it is screened.

Shade. Trees are very desirable about the home, but they should not be so dense as to shut out sunlight, nor should they be too close, because leaves will fall in the house gutters.

Water Supply. One of the richest blessings of any farm is good, pure drinking water. It is of the greatest importance that wells are carefully covered over and that no surface water is allowed to run in over the unguarded edges. Surface water is always more or less dangerous, because it may carry a small amount of sewage which contains the typhoid germ. After water has soaked through a few feet of earth it is said to be filtered and free from germs. Every well or cistern should be provided with a modern pump. The old-fashioned bucket is a danger to health, since careless people drink directly from it, perhaps leaving disease germs in the vessel which endanger others. Cistern water is more liable to contain disease germs than that from wells, because the water comes from house gutters, where in dry weather many germs are carried by the wind. Although many of these are killed by sunlight, those that escape are carried into the cistern.

Sewage a Source of Disease. Surface streams are most to be feared. If they have passed close to neighboring houses and their outbuildings, the water should never be considered drinkable without having first been boiled or filtered. Water may

look clear and pure and yet be dangerous to health. The thing that most often pollutes water supplies is sewage. Sewage is the term given to house refuse such as grease, soap, and human waste. It has in it millions of microbes or bacteria, some of which, if taken in drinking water, cause typhoid fever, others the cholera. Typhoid is one of the leading causes of death in our country, and it is caused by drinking water or milk polluted by sewage.

River Water. A river which has passed many towns in its course is not a safe water supply. Rivers will purify themselves if the water is allowed to run many miles without receiving a fresh supply of sewage, but when they have been the receiving place for the sewage of many cities the water becomes so laden with deadly bacteria that epidemics of typhoid have been known to break out in several towns along the stream at the same time.

Mosquitoes. Mosquitoes are troublesome and dangerous pests which carry the germs of human disease. Malaria is spread by mosquitoes, and in no other way. The malaria microbes are taken into the system of the mosquito with the blood sucked from people troubled with disease. In the body of the mosquito, the malaria microbe undergoes a change that is necessary to its life, so if all mosquitoes were destroyed, malaria microbes could not thrive and spread. When the mosquito attacks a well person, some of the microbes pass from it to the human system as the insect sucks the blood.

Yellow fever is also spread by a certain kind of mosquito which is common in our Southern states. By destroying the water breeding places, the yellow fever has been stamped out of such cities as New Orleans. Mosquitoes on the farm may be disposed of by draining pools of standing water so the pest cannot multiply. Large ponds may be covered with oil so the "wigglers" which hatch into mosquitoes can not get air at the surface of the water. Barrels or other vessels filled with water must be emptied or covered with oil.

The House Fly. The eggs of flies are laid in wet, decaying refuse, such as manure, slop, dead animals, garbage, and human waste. The eggs hatch into maggots which feed upon these materials and grow rapidly. Then they cover themselves with a leather-like case and are quiet a few days, after which they come forth as full-grown flies. It requires only a few days for the egg to grow into an adult fly. A few flies live through the winter, and these start broods in the early spring. By the end of summer there are flies without number.

Flies as Disease Carriers. Flies carry upon their feet and mouths the germs of disease. They visit all sorts of filthy places to lay their eggs and afterwards approach our kitchens in search of food, and wherever they crawl they scatter disease germs. The house fly has been called the typhoid fly.

Fighting Flies. There are two ways to protect the family from flies. One is to clean up all garbage

piles and filth where flies breed and to sprinkle diluted carbolic acid about such places frequently. Carbolic acid drives away the flies and kills many typhoid and other disease germs. The other remedy is to screen the house thoroughly, especially the

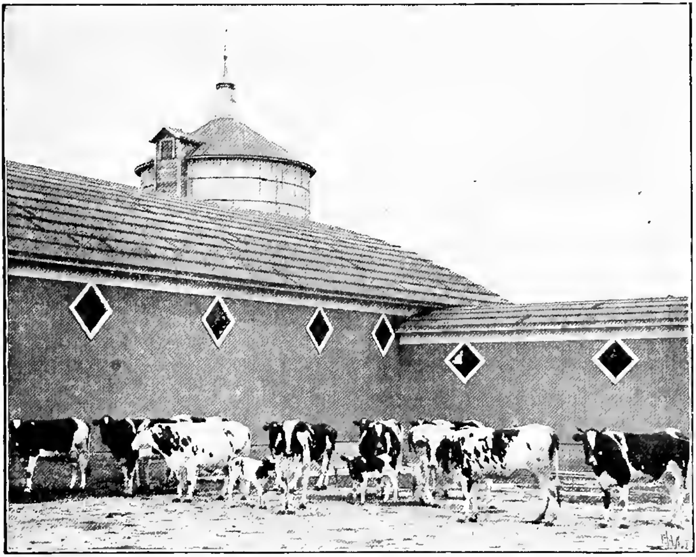


Fig. 107. *A sanitary dairy barn.*

kitchen and living rooms. No house is complete until it is fitted with screens.

Milk a Germ Carrier. It is known that milk spreads diphtheria and tuberculosis as well as typhoid fever. The typhoid germs are in the water in which the cans are washed. The ceiling of the cow stable should be dust-proof and the floor cement, so it may be washed often. Some apparently

healthy cows have tuberculosis and in many places where milk is sold to cities the cows are examined and tested for this disease.

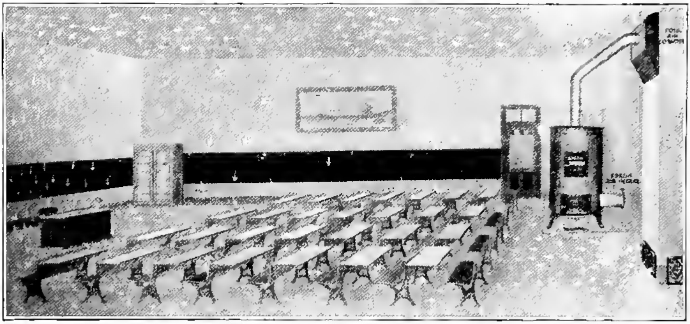
Ventilating the Barn. The average barn is not very tightly built and plenty of air enters for the stock through the cracks, but the newer barns are now built tight and warm, and in this case some means should be planned to ventilate, because bad air is the cause of the spread of tuberculosis among cows as well as among the human family. Window ventilation is far better than none, but the cold draft should not strike the cows and other stock. (Fig. 107.)

Cold Air Heavier than Warm. Every boy and girl knows that cold air is heavier than warm air and so the warmest air in the room is always near the ceiling. One reason smoke goes up the chimney is because it is carried up by warm, light air, while heavy, cold air is crowding in to take the place left by the warm air.

Best Barn Ventilation. The best way to ventilate any building, home, school, or barn that must be kept warm is to take out the colder air near the floor instead of the warm air near the ceiling. For this purpose there should be an air shaft leading from near the floor to the roof to carry out the air.

Home Ventilation. The best way to heat and ventilate a home is probably the hot-water system, placing the radiators in each room near the wall. Behind each radiator is an opening through the

wall. The outside fresh air comes in through the radiator that warms it. Beside the chimney are air vents leading from points near the floor of the room to the attic. The cold air of the room enters these air vents near the floor and passes to the attic, where openings lead to the outside. The heat of the chimney keeps the air vents warm, causing them



Courtesy of the Smith Heating Co.

FIG. 108. *A well-ventilated country school.*

to draw the colder air out of the room like another chimney. The hot pipes that extend to radiators on the second floor might be arranged to extend up the other air vents, heating the air and sucking the cold air out of other rooms. Each bedroom should be well ventilated either by an air vent along the chimney or by an open window. Bedrooms ought never to be less than ten by twelve feet, with a ceiling not lower than eight feet.

School Ventilation. These same principles of ventilation apply to schoolhouses. Where the

schools are consolidated in one large central building the fan system to drive the air in and out is the best in use. There are now excellent ways of heating and ventilating one-room schools without opening windows, and no country schoolhouse can afford to be without such a moderate priced blessing. (Fig. 108.) The illustration shows a heating and ventilating system where the fresh outside air passes in near the furnace and is warmed. It then circulates as the arrows indicate. The cold, foul air near the floor is drawn out by the opening into a separate chimney flue at the floor level. The best way to prevent and to fight tuberculosis, either among cows or human beings, is with plenty of good, fresh fair. Keeping the house and the barn supplied with plenty of fresh air and sunlight is the greatest safeguard to health.

School Lighting. The only *perfect* way of lighting a schoolroom is from the top, which is nature's plan. (Fig. 109.) The children's eyes should be protected from the strong light from side windows, because the eye, like a camera, can adjust itself to but one intensity of light at a time. The strong glaring windows cause the pupil of the eye to close so much as to make all objects in the room look dim and the eyes are strained, trying to see clearly. The only way to secure a well-distributed, even light is from skylights, and country schools, being of one story, can easily be provided with them, and the protection to the children's eyes justifies the cost.

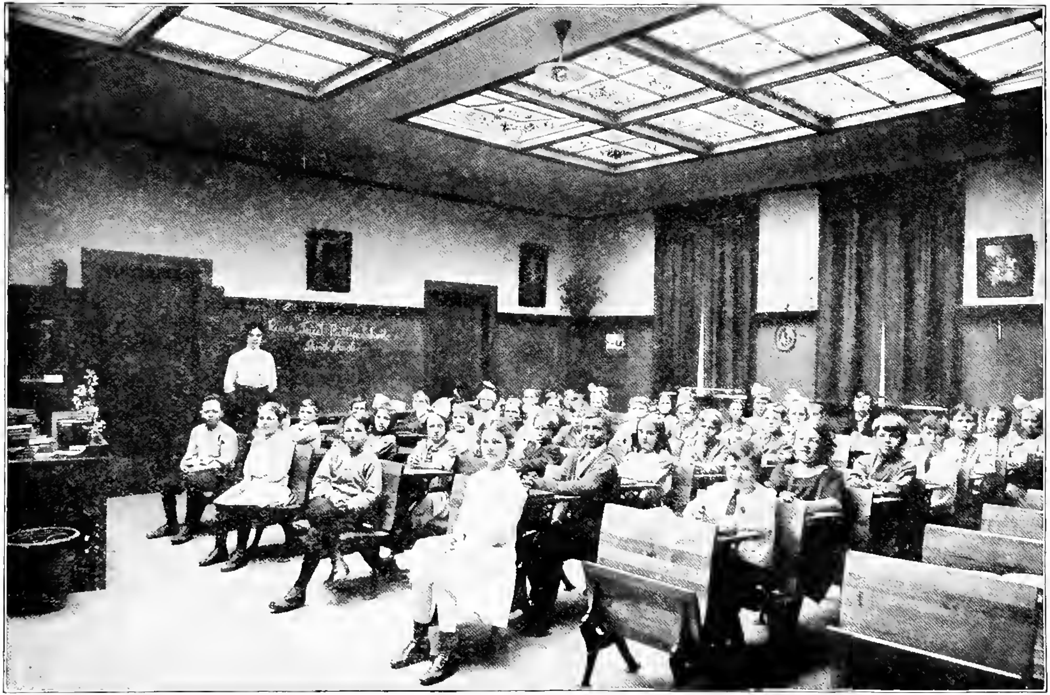


FIG. 109. *The first top-lighted school, River Forest, Illinois. A soft even light. No windows glaring*

CHAPTER XXVI

THE FARMER'S COLLEGE

Educating the Farmer. When the farmers have good crops, the whole country is happy, and business is good. A crop failure not only harms the farmer, but causes the wheels of industry and business to stop, and the result is hard times. Thus, you see, the entire country is interested in good crops.

The United States Government has become greatly concerned about the farmer's success and has established a college for farmers called the Department of Agriculture. This department is located at Washington, but it has branches in every state in the Union. It is not like the ordinary college, for farmers cannot leave their crops and stock to attend it. The Department of Agriculture has hundreds of learned men studying and experimenting all the time. They are finding out all about soils and farm crops, about animals, their care and diseases, about plants and their enemies. Everything that will help the farmer to raise splendid crops, this college is learning about. And they will send out to any farmer who asks for it, all the wonderful knowledge that has been discovered.

Learning the Best Way. Now, instead of guessing at what is best to do, or depending upon the advice of a neighboring farmer, who may be even

more ignorant than ourselves, we can just drop a one-cent post card in the mail box or post office addressed like this:

The Department of Agriculture,
Washington,
D. C.

We may ask about any crop, or about soils and tillage, or about farm stock and how to raise and feed them, or how to destroy insects. In a few days comes a little booklet to us with all the latest knowledge about the things we are interested in. This college, or department, will even advise about farm buildings, farm machinery, poultry, and many kinds of wild game. If you are planning to build a hen-house, you had better learn the best way, as it costs nothing to find out. For some of these thousands of booklets, prepared for the help of the farmer, a small price of ten or fifteen cents is asked, but the most of them are free. What a wonderful thing it is to have a real education in farming! The Government is spending millions of dollars each year to help the farmer, and thousands of intelligent farmers and their boys are becoming students of agriculture.

Not only will this department help the farmer and his sons with their problems, but the farmer's wife and daughters can get advice about milk, butter, and cheese, about canning fruit and how to preserve food, and about many other problems of the farm home.

Experiment Stations. Besides the Department at Washington, every state has experiment stations where learned men are making tests of crops, animals, and whatever the farmers of that particular state may wish to know. These experiment stations are also kept up with tax money, and the farmers

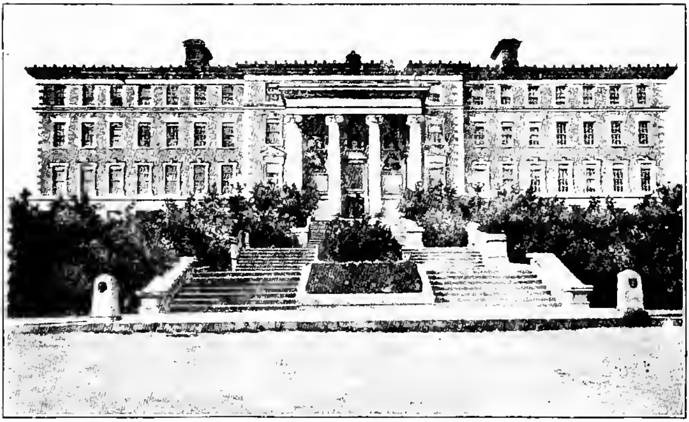


FIG. 110. *College of Agriculture, University of Wisconsin.*

have a right to the knowledge and discoveries made here. Booklets from the experiment stations are mailed free to any one engaged in farming. Should a disease of animals or plants suddenly break out in some community, a man will be sent upon request from the experiment station to advise and show the farmers how to fight the trouble. The farmers of Dakota have gained ten millions of dollars through the secrets learned at the experiment station about grain. We have learned that the Babcock test has

changed the dairy industry of the whole world. Dr. Babcock is one of the clever men who has spent his life helping to solve the farmer's problems in the Wisconsin Experiment Station.

Colleges of Agriculture. If a boy is plucky he will gain much useful knowledge about farming from these booklets. But every state also has its school of agriculture, a real college where farmers' sons gather by the hundreds to study the problems of the farm (Fig. 110). Every young man who is looking forward to the farmer's life should resolve to take a course in such a college, even if it is only for a few months in winter. The farmer of the future will have to know more than those of the past in order to be successful. So one had best prepare well by taking a full course. If, however, a boy cannot be spared from the farm so long, or if he has not the funds to pay his way through a long course, there are shorter courses for him. Many wise farmers, who need their sons through the crop season, are sending them to some College of Agriculture year after year for the winter terms, when they can be spared from the farm. A few winters spent in this way will open the boy's eyes to many interesting and important secrets of success. He will then no longer wish to leave the farm. The farm offers a delightful place on which to live, but in order to be successful one must have good training and good judgment. These, with industry, will bring happiness and prosperity.

CHAPTER XXVII

BOYS' AND GIRLS' CLUBS

More Food Needed. The population of our country is increasing very rapidly, much faster than the production of food; and so the cost of everything we eat is a great deal higher than formerly. Every citizen is, therefore, interested in increasing the farmer's crops by methods of scientific agriculture. Not only are the farmers anxious to improve crops, but business men, journalists, and statesmen are all helping along the movement. People are realizing more and more how closely their living, their prosperity, and their business success are linked with the work of the farmer who produces the nation's food.

The Whole Country Interested. Not only are farm journals teeming with suggestions and advice, but magazines and newspapers of all descriptions are spreading the great truths of scientific tillage and stock-raising. Business men's clubs are offering prizes to boys for the best acre crops, and the champion corn raisers are getting large money prizes and often splendid trips to the state or nation's capital with all expenses paid. President Roosevelt during his term of office appointed a commission consisting of eminent men to study country life and make such recommendations as seemed wise to them.

Agriculture in Schools. The principles of agriculture are rapidly being introduced into the rural schools as part of the course of study. Thirteen states now require the teaching of agriculture in the common schools. It is also encouraged and taught in thirty-one other states, which have not as yet required it by law. This makes in all forty-four states where agriculture is being taught in some measure. Many city schools are also attempting some work in connection with school gardens. (Fig. 97.)

Field Agents. The Department of Agriculture has been studying and investigating for a long time, and they have been sending out millions of copies of pamphlets to any one asking for them. But since so many farmers are not alive to their need for instruction and are not reading these pamphlets, the Department is now sending out expert men as field agents (Fig. 111) to meet the farmers and to encourage them to form for their own improvement such organizatious as cow-testing associations and the like. For boys there are Cotton Clubs, Corn Clubs, and numerous others; while for girls there are such organizations as the Girls' Garden Clubs and Tomato Canning Clubs. (Fig. 112.)

Club Movement Spreads. The club movement among country boys and girls has grown in a remarkable way. At the close of June, 1913, there were 60,000 club members doing the regular club work of raising a crop under the special instructions

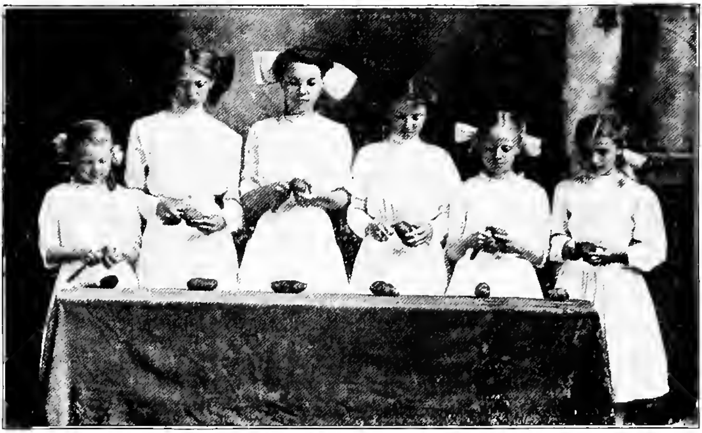
furnished by the Department of Agriculture. Aside from the clubs already mentioned are Good Roads Clubs, Poultry Clubs, Vegetable Garden Clubs, Sugar Beet Clubs, and Father and Son Clubs.

Boys' Corn Clubs. The Corn Club idea started in the South in this way. The boys of a county

Courtesy of U. S. Dept. of Agriculture

FIG. 111. *Mr. O. H. Benson, specialist in charge of National club work, conducting a School of Instruction in Home and School Canning Methods.*

were invited to join such a club and were assisted in forming the organization. During the winter they held meetings and studied the pamphlets received from the Department at Washington. These gave them information about selecting seed and fertilizer, and how to plant, cultivate, and harvest the crop.



Courtesy of U. S. Dept. of Agriculture

FIG. 112. *Play and contest a part of the game in National club work. (Grading: Skill, 30%; speed, 30%; weight of peeling, 40%; Total, 100%.)*

In the early spring the boys selected seed and tested its power to grow, or germinate, by taking a few kernels from each ear of seed corn.

The Crop. Then each boy was allowed an acre of ground and expected to keep a careful account of the money spent on his crop in labor and fertilizer. Even when he did the work himself he charged ten cents an hour against his crop and five cents an hour for each horse used. The rental value of the land was placed at $5 per acre and that, too, was charged against his crop, while for each load of manure another $2 was charged.

Net Profit. When the crop was sold, the lad deducted from the amount of money he received for

it, all the cost of raising, which included labor, fertilizer, and other expenses. What was left after this subtraction was clear gain or net profit, as business men call it.

Growth of Corn Clubs. Corn Clubs have been organized in large numbers in the Southern and Central states, and they are doing a splendid work for every county in which they are found. The boys are opening the eyes of their parents and neighbors to the wonderful increase in the crop when some attention is given to scientific culture. (Fig. 113.)

Courtesy of U. S. Dept. of Agriculture

FIG. 113. *A Wisconsin club winner and his prize bushel of seed corn.*

The 1912 Crop. For the season of 1912 the average yield of all the Corn Club members who reported to the Office of Farm Management was 74.5 bushels per acre. Fifteen club members made a yield of 140 or more bushels per acre. Sixty-one boys made over 120 bushels an acre. The average net profit an acre of all club members reporting was $25.55.

Illinois. The average yield of Corn Club members from Illinois was 79 bushels per acre, but eighty-six members made over 100 bushels an acre. There were more than 5,000 members in that state alone and $2,000 was given out as premiums to the high score boys.

Indiana, Kentucky, and Ohio. Indiana, with 3,000 members, grew an average of 78 bushels per acre. It is said that the work of the club members in Kentucky contributed $10,000,000 to the wealth of that state. One boy in West Virginia grew 140 bushels, while four others raised 120 bushels or more. Ohio members who reported averaged 94½ bushels per acre.

Father and Son Clubs. In Kentucky there are many Father and Son Clubs in which the father raises ten acres of corn alongside the son's one acre, and both follow the same careful instructions in selecting seed, planting, and cultivating. The champion father and son of that state in 1912 were Herman Gallrein and his son, Edward G. Gallrein, aged fourteen. The son raised 146 bushels and 36 pounds of white corn on his acre and his clear profit was $67.32. The father grew ten acres of the same kind of corn on land adjoining the boy's one acre; and his average per acre was 139 bushels and 45 pounds, which brought a net profit of $69.91 per acre. Both cultivated their crops eight times, the first being a rather deep cultivation, while the seven others were shallow.

Potato Clubs. Cumberland County in East Tennessee has a schoolboys' Potato Club, that has taught the farmers of that section an important lesson. It had been supposed that potatoes were not a profitable crop in that state. It was claimed that the cost of raising an acre of potatoes there, includ-

Courtesy of U. S. Dept. of Agriculture

FIG. 114. *Idaho boys and girls receiving field instructions on the diseases of the potato.*

ing labor, fertilizer, and the rent of the land, was about \$75 per acre, while the crops raised hitherto at the rate of fifty cents a bushel brought a return of only \$40 an acre. But the Boys' Potato Club told a different story. One lad raised on one acre 384 bushels and his net profit was \$78. Another boy raised 379 bushels which gave him a net gain of

$111. Each of these lads received a $40 prize. There will now be more attention given to potato raising in East Tennessee. (Fig. 114.)

Tomato Canning Clubs. The Girls' Canning Clubs are also doing splendid work in many counties, especially in the Southern states. They are usually organized by women field agents from the Department at Washington. Each club member receives instructions about growing and canning vegetables, especially tomatoes. (Fig. 115.) They are learning to can this vegetable so it will keep; they are learning to make excellent catchup, chow-chow, chili-sauce, and other relishes. Many fine recipes are sent to them from Washington. They are also taught how to market their goods to the best advantage.

Girls' Profits. The Virginia girl who made the best record for high yield in tomatoes in 1912 obtained 5,928 pounds of tomatoes from her tenth of an acre plot in that season. Many girls have made a profit of over $100 from their tenth-acre plots with one crop. One Mississippi girl is paying her way through the State Normal School by canning work.

Prize Winning Girls in Washington. During four or five days of December, 1913, fifteen girls, one from each of the Southern states, had a free trip to Washington as a prize for high class work in tomato canning. They were the fortunate winners from 25,000 girls who were enrolled in the canning clubs during that year. The prizes and trips are not

furnished by the Government, but by public spirited people,—bankers, business men's organizations, and women's clubs.

Seeing the President. For several years the state champion corn raisers have had the free trip to Washington. The winners of the several counties had their exhibits displayed at the county fairs,

Courtesy of U. S. Dept. of Agriculture

Fig. 115. *An Ohio girl in her Tomato Club plot.*

and the county winners were met by the state governor and the high score boys were sent off with much applause to the nation's capital. They have usually visited the Secretary of Agriculture and called on the President at the White House. They have been everywhere treated as distinguished visitors. On one occasion they were invited to meet

the Committee on Agriculture of the House of Representatives, and the chairman of that committee declared the boys' and girls' clubs movement to be the best work the Department of Agriculture had ever attempted.

Getting Information. It is impossible in this short chapter to give all the information necessary to form any club, but all one wishes to know may be obtained from: Office of Farm Management, Department of Agriculture, Washington, D. C.

The Club and School. These clubs are the very best way of connecting the work of the country schools and the farm home. Parents and teachers are working together in this movement. Since the teacher is likely to be crowded with her work of teaching reading, arithmetic, and the other important subjects that the children must know, she cannot do very much experimenting in school hours in the way of agriculture. So the club which meets after school, in the evenings or on Saturdays, is the best means of teaching good practice in agriculture and home canning. In this way the entire neighborhood is receiving instruction. Our Government realizes that the future of American agriculture is largely dependent on the boys and girls of to-day, and it is the purpose of this club movement to assist in instructing and directing the youth of our villages and rural communities so that they will appreciate the fact that farming is a dignified, important, and profitable life work.

PART III

APPENDIX

ONE THOUSAND QUESTIONS ON AGRICULTURE ANSWERED

DRAWN FROM THE BEST WORKS ON THE SUBJECT, ACCURATE AND UP-TO-DATE, AND WRITTEN IN SIMPLE LANGUAGE

FOR TEACHERS AND FARMERS

Plant Life

1. How many parts are there to a plant?

There are five: (1) root; (2) stem; (3) leaf; (4) flower; (5) seed.

2. What are the purposes of roots?

Roots have three uses: to hold the plant in place and prevent its blowing away; to take nourishment and moisture from the soil; and to serve as storage places for plant food.

3. What is a root cap?

The tip of the tender root has a little cap on the end to enable it to force its way among the soil particles without injury.

4. What are root hairs?

They are a hair-like velvety growth covering the real roots.

5. What is the use of root hairs?

The root hairs present a much greater surface

through which the plant may absorb food and moisture.

6. Do not the real, or fibrous roots themselves absorb food and moisture?

No, this is the work of the root hairs, which cover the fibrous roots.

7. Do the root hairs have openings or mouths through which to take food?

No, their walls are very thin and the plant food, in order to enter, must be in a soluble or watery form which passes through the thin walls of the root hairs

8. What is the name or term of this passing of liquids, or exchange of liquids through thin partitions of membranes?

It is called *osmosis*. It is the same process by which food passes from the alimentary canal of animals into the blood.

9. How does the real or fibrous root grow longer?

The root grows only at the tip, and it does not grow straight, but in a winding fashion to take advantage of the openings between soil particles.

10. What are the uses of plant stems?

They support the leaves and hold them up in the air and sunlight. They serve also as storehouses for starch and sugar and other forms of plant food for the future use of the plant. The stems are also channels for the passage of sap through the plant.

11. What is the office of the sap?

It carries raw plant food from roots to leaves and then carries the manufactured food like starch and sugar to the place where it is needed to build up the plant or to the place of storage.

12. What functions have leaves?

To give off water to the air, to take carbon from the air, and to change raw plant food to starch and sugar. They are the food factory of the plant.

13. In what form does carbon exist in the air?

The air contains carbonic-acid gas, which is a compound of two elements, oxygen and carbon. It is also called carbon dioxide.

14. Where does the air get the carbonic-acid gas?

It is exhaled or breathed off by all animal life. It is also given off by decaying plant life.

15. How does the leaf get hold of this carbonic-acid gas?

The air may enter the leaf through openings on the underside called stomata, the word meaning "mouths."

16. How does the leaf separate the carbonic-acid gas into oxygen and carbon?

The heat furnished by sunlight and the green coloring matter of leaves called chlorophyll act together and separate the oxygen from the carbon.

17. What becomes of the oxygen?

It is given off to the air.

18. What becomes of the carbon?

It is combined with other food elements to make

compounds such as starch or sugar, which are then ready to build up the plant.

19. What other use have the stomata or mouths which cover the underside of leaves?

They not only take air in, but they allow water or moisture in the leaf to escape through them into the air.

20. Are these stomata always open?

No, they may be opened or closed according to the weather.

21. Why are they closed?

In dry weather they are closed to keep moisture from passing too freely out of the leaves into the air.

22. Is the green chlorophyll necessary to the manufacture of starch and sugar by plants?

Yes, only those plants which have chlorophyll are able to use carbon dioxide from the air and change it in this way.

23. Are there any plants that grow in the dark?

Yes, mushrooms grow in dark places, but they have no chlorophyll and can get no food from the air nor from the real soil. Their food comes from partly decomposed matter in the soil.

24. What is meant by the balance in nature?

Animals need large quantities of oxygen which plants give off; while plants need large amounts of carbon dioxide which animals give off. What is poison or waste of animals is food for plants and vice versa.

25. What four things are needed by plants besides plant food?

Plants need light, heat, moisture, and air.

26. What is the main aim of life for all plants?

It is to produce seed.

27. What part of the plant has the work of bearing seed?

The flower.

28. Are all flowers alike in their parts?

No, there are many variations in flowers.

29. What parts has a perfect flower?

A perfect flower has pistils and stamens.

30. What is the office of the stamens?

Stamens are the male part of the flower. They bear the yellow dust or pollen, which is needed to fertilize the pistil or female part to enable it to produce seed.

31. What are imperfect flowers?

The flowers of many plants do not contain both male and female parts. Some have only stamens, others only pistils.

32. How do imperfect flowers bear seed?

The pollen must be carried to the flowers having the pistil by some means.

33. How is pollen carried?

The pollen of corn, being light, is carried by the wind. In some cases it is carried by insects, such as bees.

34. Why are some flowers bright and showy?

To attract the eyes of insects so that they will carry the pollen from the stamens to the pistils.

35. Why are some flowers fragrant?

For the same reason that they are bright in color, to attract insects.

36. What is cross-pollination?

Plants are cross-pollinated when the pollen is taken from one to another by some means. A number of varieties of apples, pears, peaches, and plums, will not bear fruit if grown by themselves; but they will bear abundantly if pollinated by other varieties that blossom at the same time.

37. What is a seed?

A seed bears within its coat a minute plant called a germ.

38. What is the purpose of this germ or tiny plant?

To develop into a new plant like the parent when proper conditions are offered.

39. How can the seed begin to grow with no leaves in the air and no roots in the ground?

Some nourishment prepared by the parent plant is stored up in the seed to feed it until it can put forth leaves and roots of its own.

40. Where is this store of nourishment?

In the bean it is in the two seed leaves. In the corn kernel a store of starch is found about the germ.

41. What part of the stem carries the water from the roots to the leaves?

In plants with netted vein leaves the water passes up mainly through ducts or conducting channels in the outer wood.

42. Through what part of the stem does the manufactured food from the leaves or sap pass down to the roots?

Just under the bark.

43. How does girdling a tree kill it?

Girdling starves the tree by preventing any food from passing down to the roots, which therefore shrivel and die.

44. What forces the water from the roots up through the stem to the leaves?

It is the same power that carries oil up the lamp-wick, and is called capillary attraction.

45. Why do fruit trees often die when they overbear?

Nearly all the food made by the leaves is required to mature the large crop of fruit and not enough passes down to nourish the roots, so the tree sometimes dies the following spring.

46. How are plants classified?

They may be classified in different ways. One way is according to length of life—as annuals, biennials, and perennials.

47. What are annuals?

Annuals are plants that live only one year from the planting of the seed to the production of new seed.

48. Name some farm annuals.

Wheat, oats, barley, peas, beans, and tomatoes.

49. Name some biennials with which the farmer deals.

Biennials live two years from seed to seed. Such are cabbages, parsnips, and common mullein.

50. What are some of the common perennials?

Perennials live more than two years, such as asparagus, alfalfa, strawberries, bushes, and trees.

51. How else are plants classified besides that of length of life?

They are commonly classified according to use, into: forage crops, grain crops, root crops, fiber crops, fruit crops, vegetable crops, ornamental plants, and timber crops.

52. Name the forage and fodder crops.

Timothy, alfalfa, sorghum, cowpea, and corn fodder.

53. What are included in the grain crops?

Corn, wheat, oats, rye, barley, and rice.

54. Name the root crops?

Carrots, parsnips, turnips, mangels, beets, and sugar beets.

55. What are the fiber crops?

Flax, hemp, cotton.

56. Name the common fruit crops.

Apple, peach, pear, plum, quince, currant, blackberry, grape, orange, and banana are the most common fruit crops.

57 What are the chief vegetable crops?

Tomato, pea, bean, cucumber, and celery.

58. How does the botanist classify plants?

According to likeness of characteristics he groups them into families and gives them Latin names.

59. How does nature scatter plant seeds?

Plants have developed different methods of scattering seeds. Some, like the cocoanut, will float on water, others, like the maple seed, are provided with wings.

60. How are animals helpful in scattering seeds?

The burdock and sticktights cling to animals and ride away to new homes.

61. Have birds any chance to assist?

Some plants have bright attractive seeds that taste good to birds and they scatter them in their flight.

62. What are some of man's methods of disseminating plants?

By using seeds, roots, cuttings, buds or grafts, man spreads the plants far and wide.

63. What are grown from seeds?

Nearly all farm crops.

64. Why is this the simplest and easiest method?

Because seeds are usually produced in great numbers, are easily gathered and stored, and they may be easily planted.

65. How are sweet potatoes and sugar cane planted?

From cuttings—a whole or a part of the sweet potato and a joint from the sugar cane.

66. Why are not apples and potatoes raised from the seed?

Because the seed of these plants does not produce new plants true to the variety of the parent.

THE FARMER AND THE SOIL

1. In choosing a farm what are the two chief points of value to consider?

   The economic, or money-making, value and the home value.

2. What is meant by the home value?

   The farm home should be in a healthful location, near to schools, churches, and desirable neighbors.

3. Which should be considered first, the home or the economic value?

   If one intends to live on the farm, the home value should have the first consideration.

4. Should a farmer invest all his capital in land?

   If it is in a pioneer country where land values are certain to rise, one may be safe in investing all the capital in land. But in older communities the higher the price of land, the lesser proportion of one's capital should be invested in the bare land.

5. When should a farmer locate near a market?

   When he intends producing cream, milk, or fruit, or even grain, for market.

6. When could a farmer afford to locate farther from a market or shipping point?

   When he raises stock almost entirely, because they can be easily driven some distance to the shipping point.

7. Is it wise to pay more for a farm near a transcontinental railroad?

Yes. It costs more to ship when two roads must be used to reach the great city market. Better live on a through line two hundred miles from Chicago, New York, or Pittsburgh, than to live fifty miles and have to change roads.

8. How far may milk and grain be hauled to market with profit?

Three miles is as far as a farmer can profitably haul his own milk, while five miles is a long haul for grains. For stock, ten miles is not far to market.

9. What bearing do wagon roads have upon farming?

One may travel two miles over a hard road with easy grades more easily and quickly than over one mile of muddy or hilly roads.

10. What other elements should be considered in locating?

Electric and telephone lines add to the value of farms, especially the former. The occupation of the other farmers may help to advertise a section for fruit or fine stock and thus bring buyers that way.

11. Is it possible to put too much capital in buildings?

For general farming it hardly seems wise for money-making uses to invest in buildings of all kinds more than one-fourth the value of the entire farm.

12. For an investment, which is better—a farm with no improvements or one with extensive improvements?

Better than either is a farm with only moderate

improvements and yet sufficient for the conduct of the farm.

13. Why did the American farmer a century ago succeed without much knowledge of the soil?

Because for countless ages nature had been storing up plant food in the virgin American soil, and crops did well if only half cared for.

14. How does farming here to-day differ from that of the olden day?

The virgin soil has nearly all been taken up, and it has been abused and worn out in many localities. Knowledge and skill are now needed to keep from exhausting all our lands and to make them yield what they did formerly with little labor or science.

15. Upon what does the profit of the farm depend?

Upon the size of the crops and more especially upon the yield per acre, provided the expense is not increased unduly.

16. Can a farmer increase the yield per acre faster than the expense is increased?

Yes. It has been proven many times that the present average of crops can be doubled at but slight advance in cost.

17. What practice of farmers has contributed most toward exhausting the soil?

Raising the same crop on a given field year after year for forty or fifty years without fertilizing or manuring or rotating.

18. How do we know that different plants take different amounts of plant foods from the soil?

Chemists have analyzed various plants and thus ascertained what elements they contain and in what proportion.

19. How many elements in the soil?

Between seventy and eighty are known.

20. Why are they called elements?

Because scientists have not been able to separate them into simpler substances.

21. Are most materials that we know simple elements?

No, most materials are compounds, that is, they are combinations of two or more elements combined in different amounts or proportions.

22. What are some compounds that are different articles because of the differing proportions of their elements?

Alcohol, sugar, starch, and fats all contain the same elements—carbon, hydrogen, and oxygen—but in different proportions.

23. Are there many compounds in a single plant?

Yes, but they may be separated and known.

24. What proportion of corn plant is water?

Of 1,000 pounds of mature corn plant nearly 800 are water, 12.7 pounds are hydrogen and 88.9 pounds are oxygen; and since both the hydrogen and oxygen come from water, nearly 900 pounds of the 1,000, or nine-tenths of the corn plant, is water.

25. Is this nine-tenths of the plant's weight all the water it needs to grow?

No, only a small part, for the leaves are constantly giving off moisture to the air, and it is from this moisture that the plant obtains mineral foods.

26. For each pound of dry matter of the plant how many pounds of water does the plant use?

About three hundred pounds of water passes through the plant for each pound of dry matter produced.

27. How much water is needed by an acre of good corn during the growing period?

About nine hundred tons—an amount that, if spread over the acre, would be nearly eight inches deep.

28. Does this nine hundred tons include the water lost by the land by drainage?

No, about as much water runs away and passes down beyond the reach of the roots as is used by the crop, so that about eighteen hundred tons of water should fall upon an acre of growing corn.

29. How does the plant obtain all the moisture?

It all comes from the ground through the roots.

30. How else is water useful to plant life besides being a plant food?

It not only furnishes about ninety per cent of the plant's weight but it dissolves other plant foods in the soil and puts them in shape to be taken up in liquid form by the rootlets.

31. What makes a plant wilt on a very hot day?

It wilts because the leaves are giving off moisture to the air faster than the roots can supply it to the plant.

32. Is there any other factor so important to plant life as is proper moisture?

No. More soils fail to produce good crops for lack of moisture than for any other cause. Too much stress cannot be laid upon the importance of an adequate supply of water in soil.

33. Do plants get any food from the air?

Nearly one-half of the dry matter in the plant consists of an element called carbon, all of which comes from the air in the form of carbonic-acid gas.

34. Is carbonic-acid gas pure carbon?

No, it is a compound of carbon and oxygen, but the plants separate these elements, retain the carbon, and set the oxygen free.

35. How can the plant separate these elements?

The green coloring matter of the leaves, called chlorophyll, with the help of the heat energy furnished by sunlight, breaks apart the carbon and oxygen.

36. Is sunlight necessary to this process?

Yes, plants grow more vigorously in full sunlight than in shade, and at night this growing process ceases.

37. Will not plants germinate in the dark?

Yes. They grow until they use up the food stored in the seed, but they have no power to use the food in the air and soil, for both chlorophyll and sunlight are necessary to do this. Analysis shows that the plant

grown in the dark contains less dry matter than was present in the seed.

38. What does the plant make of carbon?

It causes the carbon to combine with water and mineral matter which are taken through the roots, and these elements form carbohydrates, proteids, and other compounds of which the plant is composed.

39. Is it necessary for the farmer to buy carbon to fertilize his soil?

No, the atmosphere furnishes free an inexhaustible supply of carbon for all vegetation.

40. What is the most costly plant food?

Nitrogen.

41. Do plants contain a high percentage of nitrogen?

Not at all. Nitrogen forms only from one to three per cent of the dry matter, or about one-half of one per cent, of the green plant. But a crop must have this proportion available in order to thrive.

42. Where do plants get their supply of nitrogen?

From the soil only.

43. Where does the soil get nitrogen to supply growing crops?

A small part comes directly from the atmosphere brought by rain water. But most of the nitrogen is taken from the air and stored in the soil by bacteria which live in small swellings, or nodules, on the roots of certain plants called legumes, such as clover, alfalfa, soy bean, cowpea, and the like.

44. How can the farmer assist these bacteria?

By stirring the soil so air can enter it, for bacteria cannot live without oxygen from the air.

45. What other aids are known?

These bacteria cannot live in an acid soil, so an application of lime, by neutralizing the acid, sweetens the soil and renders it an agreeable home for the bacteria.

46. Is there more than one kind of bacteria in the soil?

Yes, there are many kinds. In fact, those that grow on clover roots differ even from those on alfalfa or other legumes.

47. Do all soils contain all these nitrogen-gathering bacteria?

No. Many soils will not grow a leguminous crop until the right bacteria have been introduced into the particular fields.

48. How are they introduced and what is the process called?

It is called inoculation and consists in taking soil from lands that have been growing the particular legume and scattering this upon the new fields, from one hundred to three hundred pounds per acre, and working it in before the bacteria die from surface exposure.

49. Is there no other way of supplying nitrogen to our soil save by raising legumes with their nitrogen-gathering bacteria?

Yes, one may use freely stable manure which is rich

in nitrogen, or one may buy fertilizer containing nitrogen; but such fertilizer is very expensive. The best method of fixing nitrogen in the soil is by raising a legume such as clover, alfalfa, or cowpea.

50. What part of the green plant comes originally from the atmosphere?

Including water, ninety-eight and one-half per cent comes from the air free of cost and the supply of these elements of food in the air is beyond control.

51. Are there many elements of food in the other one and one-half per cent of green plants?

Yes, about a dozen, but the three needing the farmer's attention are nitrogen, phosphoric acid, and potash, which are used by plants in larger quantities than the other elements.

52. Are not the other elements as necessary as these?

Yes, but most soils contain the other elements in abundance. Occasionally soils are found that are deficient in lime, but in most cases sufficient lime is present for all plant growth.

53. Is all the nitrogen or phosphorus or potash in a given soil available to plants at once?

No. The greater portion of them is locked up in compounds in such a form that plants cannot get hold of them.

54. Is there danger of exhausting the available portions of these elements?

Yes, constant cropping of cereals, especially wheat,

without rotation will practically exhaust the available nitrogen.

55. Is there any way the farmer can assist nature to change the complex compounds into simpler forms, so the elements may be available to plants?

Yes, the most helpful assistance is through good tillage. By tillage is meant stirring and pulverizing the soil by means of plows, harrows, cultivators and the like, either before or after the crop is sown.

56. In what way does pulverizing the soil help?

It loosen the soil and makes it easier for the plant roots and root hairs to penetrate the soil.

57. How is plant food taken from the soil into the rootlets?

No plant food can be taken up except in solution. Plant roots are covered with innumerable tiny hairs which drink in the liquid food.

58. Are there openings or mouths in the root hairs?

No, but the walls are so thin that the watery food easily passes through.

59. Is it possible for root hairs to penetrate solid or hard earth clods?

No, they are tender and can only push their way between the soil grains; and if the soil is not pulverized, they are barred from entering at all.

60. Where do the root hairs feed?

On the surface of the soil grains. The better the soil is pulverized the more surface is exposed to the root hairs and the more food they get from the soil.

61. How does pulverizing increase the area of soil exposed to root hairs?

A cube two inches each way presents a surface of twenty-four square inches. If this cube is cut into eight smaller cubes the exposed surface is doubled. As this breaking up continues the surface area increases amazingly.

62. Besides increasing the area of soil particles and making room for more root hairs, how else does tillage help?

Stirring the soil brings different particles into contact and having different elements they act chemically upon each other, releasing plant food by breaking up compounds.

63. What effect does tillage have upon air in the soil?

Tillage introduces more air into the soil, and the oxygen of air is needed by the roots of all farm crops. Oxygen makes seeds germinate, and it helps to make the mineral elements soluble in water so plants can get them.

64. What effect does air have upon organic matter in the soil?

The oxygen of air helps to decompose organic matter in the soil, and to put it in form to be used by growing plants.

65. Are there bacteria in the soil that help the decay of organic matter?

Yes, and these bacteria cannot live without the oxygen of air.

66. Where do the bacteria that live on the roots of legumes get the nitrogen which they store up in the roots of the plant?

They get it from the air alone.

67. Do they come to the surface for air?

No, the air must be in the soil and the looser and better pulverized the soil, the more air there is in it.

68. What effect has tillage upon moisture in the soil?

It enlarges the water supply by giving the soil greater capacity for holding moisture.

69. How is the water-holding capacity of soil increased by tillage?

Each soil grain is covered by a thin film of water, and the finer the grains of soil, the greater surface area on a cubic foot of them and the more water they will hold on their surface.

70. If good tillage breaks the soil particles into grains only one-tenth their former size, what effect has this upon the extent of surface of the particles?

Reducing the size to one-tenth, multiplies the surface area by ten.

71. If the soil particles of an acre of soil were reduced to one-tenth, would it make the one acre equal to ten acres?

Yes, it would supply ten times as much moisture and mineral matter to the crop, or as much as ten acres not so tilled.

72. What is more important than moisture for the farmer?

Moisture in the soil is one of the farmer's chief problems because ninety per cent of his crop comes from water.

73. Do crops ordinarily get sufficient water?

No, they seldom get enough water for the maximum yield.

74. Can the farmer influence rainfall?

No, but by good tillage he can save for his crops a large part of the water that may otherwise go to waste.

75. How can he do this?

By good tillage and finely-pulverized soil, the ground is made to absorb and hold a large amount of water, and a dust mulch helps to retain this moisture for the growing crop.

76. What is meant by a dust, or earth, mulch?

It is a finely-pulverized surface of two or three inches that prevents evaporation of soil water.

77. How is this explained?

Where the ground is firm, water is drawn up from below by capillary attraction as oil passes up a lamp-wick, and the soil water evaporates rapidly into the air. Fine tillage breaks up this capillary attraction and a finely pulverized surface acts as a blanket to prevent this evaporation.

78. Are there other ways of preventing this loss of soil water?

Yes, by covering the ground with loose straw or hay, or even with weeds, evaporation may be prevented.

79. What kind of cultivation makes the most effective dust mulch?

The cultivation should be shallow and frequent with the aim of making a surface layer as fine and dry as possible.

80. How does rain affect a surface mulch?

It hardens or forms a crust on the surface and capillarity starts again.

81. Should the farmer cultivate after each rain?

Yes, for the best results.

82. Is cultivation needed in the absence of rain?

Yes, the soil will become too compact if left without stirring.

83. During what season should the soil be stirred most frequently?

In the spring, in order to hold the water from spring rains.

84. Can one make a mulch on a sandy soil?

Yes, sandy soils produce better results from mulching than clays or loams.

85. What advantage has late fall plowing for spring crops?

It prevents evaporation and enables the soil to absorb more water from the winter rain and snow.

86. Is it well to plow all soils in the fall?

No, it is better not to plow hard soils that are low in humus.

87. Does early spring plowing help to increase soil water?

Certainly, the wise farmer always plows early.

88. Is it possible to plow too early?

Not if the ground is right and not too wet.

89. What other advantage has tillage?

Tillage destroys weeds which rob the crop of moisture and plant food. All growing plants pump up water through their roots and give it off through the leaves.

90. What two forms of water exist in the soil?

Film moisture and ground water.

91. How does ground water differ from film moisture?

Film moisture is a thin coat of moisture on each soil grain. Ground water occupies the spaces between the soil grains.

92. What is the surface of this ground water called?

It is called the water table.

93. How near the surface is the water table?

In some soils it is very near the surface, while in others it is many feet below.

94. How can one find out the depth of the water table?

By sinking a hole to such a depth that the water will stand in it. The level of the water in the hole is the same as the water table.

95. In what kind of ground is the water table at the level of the ground?

In marshes and swamps.

96. What objection is there to a high water table?

When the level of the ground water is near the surface of the soil, it limits the space where plant roots

may feed, for they will not penetrate soil that is water-soaked.

97. Why will not roots penetrate water-soaked soil?

Because roots must have air about them, and water drives out air.

98. Will not plant roots go below the water table?

No, this is why plants can not be made to grow in swampy land.

99. How may a farmer lower the water table?

By under drainage with tile.

100. How will tiling improve the soil?

The tile carry off all stagnant water near the surface and lower the water table, thus rendering a deeper soil for the plant roots.

101. What changes follow the lowering of the water level?

Air, with its oxygen and carbonic-acid gas, enables roots, earthworms, and bacteria to reach a greater depth.

102. Why is well-drained soil safer from drought?

Because good drainage enables the roots to penetrate deeper and because plants live on film moisture which is increased by good drainage. Roots will not penetrate free water.

103. Do not tile drains carry away too much of the rain water in dry weather?

No, because the water does not reach the drain unless the rainfall is excessive enough to raise the level of free water in the soil to the drain pipes.

104. Do tile drains carry off film moisture in the soil?

No, only the free, or ground, water which keeps roots from reaching down deep into the soil.

105. Is it ever well to tile-drain high lands?

Sometimes with heavy clay soils it is, because the subsoils will allow water to pass through them so slowly that it is about the same as a water table.

106. How does tiling affect such soils?

It makes these soils more mellow, and they respond to tillage better.

107. What is humus?

It is formed by the decay of organic matter, and it gives a rich black appearance to the soil. The black mould under the leaves in the forest is humus.

108. What are the sources of humus?

In most cases it comes from the decay of plants which have been previously grown on the soil, but it may also come from manures.

109. How does cropping affect the amount of humus?

Continued cropping, with no way of replacing the humus, reduces it one-third or even one-half.

110. Why is humus needed in the soil?

Humus increases the power of the soil to absorb and retain water. But more important than this, it furnishes elements of plant food.

111. How does humus do this?

Humus in the soil acts like a sponge, but holds the water in such form that plants can get it.

112. Does humus contain plant food?

Yes, it is a storehouse for plant food, especially for nitrogen.

113. How else does humus aid crops?

Humus enables plants to obtain more plant food from the soil.

114. How may humus be restored to worn-out soils?

Plowing under green crops, which is called green manuring, is one method practiced by some good farmers.

115. What is the best crop for green manures?

Legumes not only add humus, as would other crops, but legumes also add nitrogen.

116. Which crop of legumes seems best for green manure?

Red clover is the most common; but cowpea, soy bean, or the ordinary field bean or field pea may be used to plow under.

117. What danger is there in green manuring?

In a dry season the growth of a crop to plow under may use up most of the moisture, leaving the following crop too little to grow well.

118. Is green manure needed on stock farms?

No, because the crop to be plowed under makes fine feed, and it is more profitable to feed it and return the manure to the soil.

FERTILIZERS

1. What is the oldest fertilizer?

   Barnyard manure.

2. Is its popularity justified?

   Yes. It has proven its importance.

3. What is the estimated value of the manure produced by an animal in a year?

   If all is saved that from the horse is worth twenty-seven dollars; from the steer, twenty dollars; from the hog, eight dollars.

4. What kind of manure is most valuable?

   Sheep manure is richest in fertilizer and horse manure is second.

5. What elements in manure render it valuable?

   The phosphoric acid, potash, and nitrogen are the chief elements.

6. Why do horse and sheep manure heat while others do not?

   Probably because that from the horse and sheep contain less water.

7. Does the kind of feed given affect the manure?

   Manure varies with quality and quantity of feed.

8. What feeds produce the best manures?

   Feeds high in nitrogen, phosphoric acid, and potash.

9. Give a few feeds in the order of their value as fertilizer.

   Cottonseed meal, linseed meal, gluten meal, wheat

bran, and corn meal, rank in value in the order given.

10. What elements do growing stock need in greater amounts than mature animals?

    They need nitrogen and phosphoric acid.

11. What proportion of the fertilizer of the feed may be recovered in the manure?

    About eighty per cent on the average farm.

12. What is the chief factor in determining the fertilizing value of a given manure?

    The age of the animal.

13. What is the most valuable element in manure?

    Nitrogen.

14. Why?

    Because nitrogen is usually present in larger quantities, and it is more costly when purchased.

15. What effect has bedding upon manure?

    The richer the bedding in fertilizer elements, the richer the manure.

16. Is it economical to pile manure in the open barn lot, exposed to the weather?

    No, the result is great loss, due to leaching from rains.

17. Is open lot feeding advisable?

    No, the loss in manure from leaching is wasteful.

18. What is the purpose of bedding?

    To absorb the liquid excrement which contains over one-half the value of the manure.

19. What bearing has this upon the amount of bedding?

There should be abundance of bedding to absorb all liquid waste.

20. How does cutting bedding affect its absorbent powers?

Straw cut in one-inch lengths will absorb three times as much urine as long straw.

21. What other advantage comes from cutting bedding?

The manure is in condition to be much more easily handled and less bedding is needed.

22. Does stored manure lose strength?

Yes. Nitrogen passes to the air in the form of ammonia which is noticed as a strong odor on a winter morning.

23. What is the best method to prevent loss in manure?

To haul it to the field as fast as it is made.

24. What other advantages are there in immediate hauling?

Manure should be handled only once if its total value as manure is realized.

25. If manure must be stored, what is the best manner?

Stored manure loses by leaching due to rains and hot fermentation. Leaching is prevented by keeping manure under shelter or by placing it in water-tight pits or bins of cement.

26. How may heating be prevented?

By keeping manure in a compact heap so air cannot enter to enable bacteria to thrive. Each daily addition to the pile should be firmly packed into place.

27. What other treatment is needed?

Water will cool the pile and keep out air, so water should be added when necessary.

28. When manure is to be stored for some time, what added direction may be given?

Cover the heap with a few inches of earth which will prevent the escape of ammonia.

29. What is the best method of saving manure?

A covered barnyard is probably the best means.

30. What advantage has this besides saving manure?

It saves labor as it is easy to gather the manure outside the stalls at any time, and it can be handled when the ground is right.

31. How is exposed manure best cared for?

By making the heap so high that the heaviest rains could not soak through it.

32. What is the best manner of applying manure?

As a top dressing.

33. What is the advantage of this method?

It is nature's way. As the fertilizer descends gradually, it feeds the plant roots, and it is not covered beyond their depth.

34. What other advantage has top dressing?

It acts as a mulch, preventing the escape of moisture from the soil.

35. What objection is there to this method?

It may interfere with tillage unless the manure is fine.

36. Should manure be spread before or after harrowing?

It should be spread after plowing, and then harrowed into the soil.

37. Should manure be left in piles in the fields?

No, because this means a second handling and increases the labor.

38. Are there other objections?

In piles it is liable to lose by fermentation and by leaching; it makes the ground under the piles highly fertilized and thus the fields are spotty.

39. What objections are there to a spotty field?

Part of the crop may grow too rank and fall, and the crop is apt to mature unevenly. In either case there is a money loss to the farmer.

40. What is the better way of spreading?

Broadcasting from the wagon either by hand or by using a manure spreader.

41. When coarse manure must be plowed under what caution is necessary?

It should not be covered too deep especially in clay soils where the air may not reach it readily to assist in decay.

42. How deep should it be covered?

In clays, about four inches, but it may be much deeper in sandy soils.

43. Is it possible to apply too much manure?

Yes. In general one should not use more than eight or ten tons per acre.

44. Is it well to try to cover the entire farm each year?

No. It is better to manure only one crop in a rotation, thus covering only a part of the farm annually.

45. How long is the effect of manuring noticed?

It may affect crops for a dozen years or more, but each year the effect is less noticeable.

46. All things considered, is there any fertilizer better than manure?

No. When barnyard manure has been properly cared for, it has no superior.

47. How does selling crops from the farm affect fertility?

The loss of fertility is much greater than where stock is fed or a dairy kept.

48. Does stock farming or dairying actually rob the farm of nitrogen, phosphoric acid, or potash?

No. It adds to the soil large quantities of nitrogen and some phosphorus, but a small amount of potash is lost.

49. Does this mean that stock and dairy farming may actually increase the fertility of a farm?

Yes. Where the barnyard manure is properly used in connection with leguminous crops and the best method of tillage adopted, the fertility may be increased without the purchase of any fertilizer.

50. Where plants fail to grow, is it usually due to a lack of plant food?

Not necessarily. Some soils are not sufficiently porous to allow plant roots to develop; others may lack either moisture or drainage.

51. Is it possible to rely too much on fertilizer?

Yes. Some farmers expect fertilizer to take the place of tillage.

52. How did commercial fertilizer come to be used?

When it was discovered that certain elements in the soil are necessary to plant growth, farmers concluded to supply these elements artificially.

53. How may commercial fertilizers be classified?

Into three classes. Those made chiefly from nitrogen sources, those chiefly from phosphoric acid, and those chiefly from potash.

54. Are there any wonderful secrets known only to certain manufacturers of fertilizer?

No. Some salesmen pretend this is true in order to make sales.

55. What is meant by the so-called "Complete fertilizer"?

It is simply a mixture of two or more basic materials in order to give the required per cent of nitrogen, phosphoric acid, and potash.

56. Where does the nitrogen usually come from?

From animal refuse matter, from packing houses, soap and glue factories.

57. What is dried blood?

It is the blood from slaughter houses dried by heating to a powder.

58. Is there more than one kind?

There is the red blood and the black blood.

59. What is the difference?

The red blood is dried more carefully and not charred, while the black blood is dried more rapidly.

60. Which is the more valuable fertilizer?

The red blood contains from thirteen to fourteen per cent nitrogen, while the black contains from six to twelve per cent.

61. What are meat meal, azotin, and ammonite?

They are all the same thing—a meat product containing thirteen to fourteen per cent nitrogen.

62. How much nitrogen in hoof meal?

It contains about twelve per cent nitrogen.

63. How valuable is horn meal?

It contains from ten to twelve per cent nitrogen, but not in good form for plant food.

64. What is tankage?

It is the dried animal waste from slaughter houses, containing from four to nine per cent nitrogen and from three to twelve per cent phosphoric acid.

65. What is fish fertilizer or guano?

The oil of the fish is extracted and the remaining "pumace" is dried and ground for fertilizer.

66. What elements of fertilizer does it contain?

From eight to eleven per cent of nitrogen and three to five per cent of phosphoric acid.

67. Is leather meal a good fertilizer?

No, because it resists decay.

68. What can be said in favor of sulphate of ammonia?

It is a by-product of coal gas and coke, resembling

common salt and is the richest in nitrogen of all fertilizing materials, containing from twenty to twenty-three per cent.

69. What is nitrate of soda, or Chili saltpeter?

It resembles salt, is entirely soluble in water, and is a very desirable nitrogenous fertilizer with from fifteen to sixteen per cent nitrogen.

70. For early spring growing crops which fertilizer is best?

Chili saltpeter, because it is immediately ready for the plants.

71. How does nitrogen compare in cost with the other elements?

It is the most expensive, costing nearly three times as much per pound as phosphoric acid or potash.

72. Is it usually advisable for the ordinary farmer to buy nitrogenous fertilizer?

No. It can best be supplied by the use of barnyard manures and by growing legumes.

73. What is the source of the potash of fertilizer?

Nearly all of it comes from the potash salt mines of Strassfurt, Germany.

74. In what forms does it sell?

Kainite, containing about twelve per cent potash; muriate of potash, containing about fifty per cent; and sulphate of potash, with about fifty-three per cent.

75. Do these furnish available plant food?

Yes. All are soluble in water and available to plants.

76. How is phosphoric acid obtained for fertilizer?

From phosphates—the bones of dead animals and minerals containing phosphates.

77. How are bones treated for this purpose?

Raw bone meal is made by grinding raw bones to a powder, the finer the better.

78. How rich is bone meal in phosphorus?

It contains twenty-two per cent of phosphoric acid and four per cent nitrogen.

79. Does bone meal decay rapidly?

No, the elements in bone are only gradually available to the crop.

80. What is the value of steamed bone meal?

Steaming removes the fat and some nitrogen, so that it contains about twenty-eight per cent phosphoric acid and one and one-half per cent nitrogen.

81. Does steamed bone meal decay more rapidly than the raw?

Yes. The removal of fat causes more rapid decay and so they are considered a better source of phosphoric acid.

82. What is bone tankage?

It is merely bones mixed with tankage and contains from seven to eighteen per cent phosphoric acid.

83. How valuable is bone black, or animal charcoal, as a fertilizer?

It is made by heating bone in air-tight vessels. It is first used to refine sugar and afterwards as a fertilizer.

It contains from thirty-two to thirty-six per cent phosphoric acid.

84. Where are the mineral phosphates found?

In the Carolinas and the neighboring states.

85. How rich in plant food are they?

They contain from eighteen to thirty-two per cent of phosphoric acid.

86. Is the phosphoric acid in mineral phosphates soluble in water?

No, because of the lime combined with it. It is sometimes treated with sulphuric acid which unites with lime, leaving less lime with the phosphoric acid which thus becomes soluble in water.

87. Why is it desirable to have the phosphate soluble in water?

Because it distributes itself through the ground better in this form.

88. What are treated phosphates called?

Superphosphates or manufactured phosphates.

89. Should farmers buy cheap, low-grade fertilizer or a higher priced brand?

The plant food is really cheaper per pound in the higher grade fertilizers.

90. How are farmers protected from dishonest dealers?

The manufacturers are required by law to guarantee the amount of nitrogen (or ammonia), the available phosphoric acid and potash that each brand contains; and this must be stated on each bag offered for sale.

91. How does lime aid the soil?

Lime changes the physical condition of sandy soils so as to make them hold water. Some soils may be deficient in lime.

92. How does lime affect clays?

It makes clays more mellow. A soil rich in lime crumbles more easily and is more readily brought into good condition for crops. It also helps to break up compounds so as to make their elements available for plants.

93. Are there other uses of lime?

Yes. It helps the growth of bacteria. It makes an acid, or sour, soil sweet.

94. How is lime applied?

It is drilled and afterward harrowed in.

ROTATION OF CROPS

1. Do all plants require food in the same proportion?

No. Different crops vary in their food requirements.

2. Why should not the same crop be grown continuously on the same soil?

Such cropping will tend to exhaust certain plant foods needed by the crop, because some crops make an especial drain on one element of food.

3. Do all crops require their food to be in the same simple form?

Some require the food, especially the mineral matter, to be in a more soluble form than others.

4. How do crops differ in their manner of root growth?

   Some plants, like wheat, being shallow-rooted, are surface feeders while others extend their roots deeper.

5. Why is it wise to rotate deep and shallow-rooted crops?

   Because they feed at different depths, and this plan will not exhaust the soil so quickly.

6. What other reason for this method?

   The deep-rooted crops probably leave near the surface some food procured deeper in the soil.

7. What is the effect of shallow-rooted crops following deep-rooted crops?

   They always do better.

8. How does rotation affect the physical condition of the soil?

   Different crops receive different cultivation and the shortcomings of one crop treatment is corrected by the next, and thus the soil is kept in better condition.

9. Does the different manner of rooting affect the soil?

   It is well to have the roots of stubble, clover, and grasses periodically left in the soil to decay. This improves the texture of the soil.

10. What effect has rotation on labor?

    Rotation distributes the care of crops throughout the season and thus economizes labor.

11. What effect has rotation on the kind of labor employed?

The farmer may keep regular help which is more reliable and efficient than transient help.

12. Does rotation affect plant diseases?

Most plant diseases are fungi or bacteria that live in only one kind of plaut. Therefore rotation starves them out.

13. What effect has rotation upon insects?

Most insects, like the fungi, have their favorite crops, and as many of them can live only a few years, they, too, are starved out by rotation, because they cannot live till the crop on which they flourish is again sown.

14. How does rotation affect weeds?

Crops are cultivated differently and also harvested in different manners and at different times, and this tends to drive out weeds by striking them at their weak point.

15. Does rotation affect insects that migrate?

No, it does not.

16. If land is badly infested with a certain weed, how can it be freed from it?

By leaving out of the rotation the particular crop whose cultivation offers aid to this pest.

17. What effect has rotation upon the size of crops?

All experiments show much better crop yields where rotation is practiced.

18. Can any general rules be given for planning rotation?

Every rotation should include at least one cultivated or hoed crop such as corn or potatoes, and one legume.

19. Why is the hoed crop desirable?

It is useful in destroying weeds and improving tilth.

20. Why should one leguminous crop be included?

Because they are deep rooted, getting food from the subsoil; they increase the nitrogen supply in the soil and leave it more porous.

21. What general rule may be given for rotation?

The crops should vary as much as possible in their food requirements, manner of growth, root system, and in the season during which they occupy the ground.

INSECTS ON THE FARM

1. How may we identify insects?

Insects have six legs when full-grown.

2. Suppose the "bug" has eight legs?

Then it is classed as a spider or its relative, a mite or a scorpion.

3. What are sow bugs?

They are bugs, having twelve or more legs, which live in damp places or in water.

4. What are centipedes?

Centipedes are many-legged worm-like creatures.

5. What other qualities or parts has an insect besides six legs?

Their bodies are divided into three parts: the head; the thorax, or middle part; and the hind part, or abdomen.

6. How do they migrate?

Some have wings and fly, some jump, and a few crawl.

7. Do all insects eat alike?

No, some bite off and chew what they eat, while others only suck the juices or sap of plants or the blood of animals.

8. Do insects have a steady growth?

No, they shed their skins a number of times; and each new skin soon stretches to two or three times the size of the old one.

9. Do the full-grown insects and the young ones look alike?

Most full-grown insects look quite different from their young. The "grub worm" does not resemble its parent, the June beetle; the caterpillar is very different from its parent, the butterfly, or moth.

10. What are some other illustrations of this difference?

The "wiggler" in the rain barrel is the young of the mosquito; the maggot is the young of the green or bluebottle fly, that lays its egg on decaying meat.

11. Describe the early stages of insect growth?

The egg hatches into a worm-like animal known as a grub or caterpillar, but more accurately, larvae, which settles down and spins a home of silk, called a cocoon.

12. What shall we find in a cocoon?

An insect covered with an outside skeleton, scarcely

able to move and unable to eat. In this state it is called a "pupa."

13. What is the next change?

After a rest in the pupa stage, the animal comes forth a mature insect.

14. How do insects breathe?

They have little holes placed along both sides of the body and through these the air passes in and out.

15. Do insects have blood like mammals?

No, their blood is transparent like water and is pushed along through the body not by a beating heart, but by the beating of a large vein or artery which lies along the back.

16. Where is its brain?

The brain of the insect is not all in one place, but scattered in knots or bunches along the principal nerve situated near the lower side in the middle of the body.

17. Have insects bones?

No, their skeletons are on the outside of their bodies.

18. Are any of them warm blooded?

No, they are cold blooded and can freeze without being killed.

19. Where do they live through the winter?

They hibernate; that is, a great many kinds live through winter hidden away among old grass or under stones, fallen leaves, logs or loose bark, and in the ground.

20. Does freezing injure the young and the eggs of the insects?

No, the young and the eggs can be frozen solid and not be injured.

21. How long do insects generally live?

Some kinds live longer than others, raising several generations, but insects generally die soon after laying their eggs.

22. Do they live to rear their young?

A great many die even before their eggs hatch. A few, like the queen bee, live much longer and even take some care of their young.

23. Do insects need much food?

Some insects eat all the time while growing, never going to sleep. They stop to rest only long enough to shed their skins.

24. How many times their own weight may insects eat?

Such kinds as live on flesh have been known to eat two hundred times their own weight of food in a single day.

25. Do caterpillars grow rapidly?

Certain kinds may increase in size ten thousand times inside of thirty days.

26. How widely are insects found?

In all countries at all times of the year. They are found in our homes, gardens, and fields; in the air, water, and the earth; both within and upon the bodies of animals.

27. Are they ever useful to mankind?

Some gather honey, fertilize flowers, and make wax. Others spin silk, and some clean away dead animals.

28. What proportion of all animal life do insects form?

They form about nine-tenths of all the animal life upon the earth.

29. Name some insects that are man's friends?

Bees, wasps, ichneumon flies, flesh flies, dragon flies, tiger beetles, burying beetles, ladybirds, and silkworms are helpful to man.

30. Of what use are bumblebees?

They gather honey and pollen, and while doing this help to fertilize plants by carrying pollen from one to the other. Red clover would not grow in New Zealand until bumblebees were taken there to fertilize the clover.

31. Are there other useful bees?

Yes, a large number of other kinds of wild bees have their favorite flowers which they cross-fertilize as they gather honey.

32. Are there many kinds of wasps?

There are "yellow jackets," "mud daubers," hornets, and many other kinds.

33. Of what use to man are hornets and "yellow jackets"?

They often catch large numbers of biting flies, like the house fly and those that worry our cattle.

34. What useful work is done by other wasps?

Some feed their young upon caterpillars; other kinds

eat grasshoppers and still others devour cicadas and the like.

35. In what ways are ichneumon flies our friends?

There are hundreds of kinds of them and they attack other insects in vast numbers.

36. How do flesh flies serve us?

They attack dead animal flesh by laying eggs that hatch into maggots, and these eat the flesh that might otherwise spread disease.

37. Is this the only work of flesh flies?

No, many of these flies have the habit of laying their eggs upon the bodies of caterpillars, grasshoppers, and plant lice. The eggs hatch and kill their hosts.

38. What other names are given to dragon flies?

They have been called "snake feeders" and "darning needles" by people who did not know much about their ways of living.

39. What habits have dragon flies that are helpful to us?

They eat all kinds of mosquitoes, gnats, and small flies.

40. What are robber flies?

They are long-bodied, strong-legged flies with faces covered with stiff whiskers, and they make a loud buzzing noise as they fly. Some are as large as bumblebees.

41. Why should we look upon them as friends?

They kill grasshoppers and many other kinds of insects, though they like grasshoppers best.

42. What is another name for locust?

Short-horned grasshopper.

43. Why are locusts enemies of man?

Because they feed on plants and most of the plants are useful to man.

44. Where do they lay their eggs?

They lay their eggs, from two dozen to a hundred at a time, in the ground, usually in the late summer or early fall.

45. How may the farmer destroy them?

By disking or harrowing in the fall, winter, or spring.

46. Do crickets and katydids do much harm to crops?

No, they seldom become numerous enough to do serious harm.

47. What kinds of insects suck blood and sap instead of biting their food?

Some are called cicadas; others, leaf and tree hoppers; and still others, lice and plant lice.

48. Are they all harmful?

Most of them are either enemies of man or of domestic animals or of plants that are useful to man.

49. Name some insects with sucking mouths.

Lice and bedbugs, squashbug and chinch bug and the like.

50. What are cicadas?

They are wrongly called locusts. One kind lives for sixteen years underground, sucking the sap from roots.

The seventeenth year they come to the surface, get wings, lay eggs on the twigs of trees and die. The egg hatch and the young drop to the ground and dig down to live as their parents did for another sixteen years.

51. How do the treehoppers and leafhoppers live?

They live on sap. Some of them have such queer faces that they have been called brownie bugs.

52. Are there many kinds?

There are hundreds of different kinds, and each one seems to be the enemy of some one kind of plant. There is scarcely a blade of grass or a weed or a cultivated plant but has several working on it.

53. What is the most common of the injurious beetles?

The "Junebug" or "Maybeetle," whose young are the grubworms found in the ground.

54. What plants do they attack?

Sometimes they attack in great numbers our fruit and shade trees, eating blossoms, leaves, and fruit.

55. How shall one fight the cabbage worm?

Cabbage worms are the young of a small white butterfly. Paris green on young plants will destroy many young or larvae. Birds kill many.

56. What is one of the worst pests of the farmer?

The chinch bug. It has caused a loss of $4,000,000 in one year in one state.

57. What means are taken to fight it?

Their winter quarters are destroyed by burning dry grass, leaves, and rubbish in fields and fence rows.

58. Does not the chinch bug have wings?

Yes, but it seldom uses them, usually traveling afoot.

59. What other method is used to fight them?

A deep furrow is plowed around the field for them to fall into, where they may be destroyed by spraying with kerosene emulsion.

60. What is the plant louse?

It is a tiny insect that multiplies very fast. It gives off a sweetish fluid of which ants are very fond. Ants are said to protect and care for them for the sake of milking them.

61. How may one fight the plant louse?

Since they suck their food, poison sprays will not kill them. They must be sprayed with kerosene emulsion or strong soapsuds.

62. Will poisons kill the squash bug?

No, about the only way to destroy them is to pick them by hand.

63. How shall we protect melons and cucumbers from these bugs?

By planting squashes alongside and picking the bugs from the squashes where they gather.

64. What plant is chiefly attacked by the Hessian fly?

The Hessian fly does more damage to wheat than all the other insects together.

65. What method is used to fight the Hessian fly?

All stubble and trash are burned to kill the wintering insects.

66. What is the San José scale?

It is one of the most dreaded enemies of fruit trees.

67. What is the nature of it?

It is small and multiplies very rapidly.

68. What precautions are advisable?

Never bring in new trees without making sure that they are free from this scale.

69. What shall we do if they are already in?

Prevent spreading by spraying thoroughly with a fire-boiled lime-sulphur mixture.

70. What crop does the codling moth attack?

The apple crop. Sometimes seventy-five per cent of the crop is lost through this pest. A loss of $3,000,000 a year has been caused by it in New York state.

71. How shall we fight the codling moth?

By destroying orchard trash, spraying the trees with Paris green as soon as the blossoms fall, and trapping the worms with cloth bands wrapped around the tree trunks.

72. What is the chief enemy of the plum tree?

The plum curculio.

73. How does it injure the crop?

It injures the plum by stinging it and depositing an egg from which a maggot-like larva soon hatches and burrows through the fruit, causing it to drop to the ground before it is ripe.

74. What then becomes of the larva?

It burrows several inches into the ground, then it

becomes a pupa and at last a beetle that comes forth to winter in cracks and crevices.

75. How can the plum curculio be destroyed?

One remedy is to spray the trees twice with a mixture of two pounds of arsenate of lead and three pounds of lime in fifty gallons of water.

76. What injury does the cankerworm?

Cankerworms devour the leaves of an orchard, destroying the crop and doing permanent injury to the tree.

77. How may one fight the cankerworm?

By protecting and furnishing needed food to the common birds, nearly all of which feed upon this pest. The chickadee will devour thirty female cankerworm moths a day.

78. What other remedy is there?

As the female moth cannot fly, the tree may be protected by smoothing the bark and fitting close to it a band of paper over which is smeared something sticky, like printer's ink or tanglefoot.

79. How can the apple-tree tent caterpillar be destroyed?

By burning the nests with torches at dusk when all the worms are inside. Care must be exercised not to burn the tender young branches of the tree by allowing the flame to approach them too closely.

80. What else may be done?

Encourage birds and spray the trees.

81. What are insecticides?

Insecticides are substances that are used to poison insects.

82. How many classes of insecticides are there?

There are three: internal poisons, contact poisons, and fumigation poisons.

83. What are internal poisons?

They are food or internal poisons like Paris green, London purple, or lead arsenate, which are used to kill insects that chew their food.

84. What are contact poisons and how applied?

They are poisons, such as oil and caustic alkalies which are used to kill sucking insects. They destroy the body of the insect, such as the San José scale.

85. What are fumigation poisons?

They are substances that enter the breathing pores of the insect and cause death by poison or suffocation.

86. What is the Bordeaux mixture?

It is a fungicide used everywhere to reduce damage done to fruits and vegetables by fungi. There are several formulas for different purposes of spraying, but the standard Bordeaux mixture is: 6 pounds copper sulphate (bluestone), and 4 pounds of lime to 50 gallons of water.

87. If this mixture injures the foliage of the trees, how is the formula altered?

The peach Bordeaux mixture may be used: 3 pounds copper sulphate and 9 pounds of lime to 50 gallons of water.

88. What is the color of the Bordeaux mixture?

When properly prepared it has a sky-blue color. If the lime used is not fresh the mixture has a greenish color which indicates that more lime is needed.

89. Is it possible to mix and use an insecticide with the Bordeaux mixture?

Yes, this is often done when internal poisons like Paris green, London purple or arsenate of lead are used. They may be added to the Bordeaux mixture at the rate of one-fourth pound to 50 gallons of Bordeaux.

90. What are lime and sulphur preparations used for?

They are much used to destroy scale insects, acting both as a fungicide and insecticide.

91. Give a common preparation of lime and sulphur.

Fresh lime, 15 to 30 pounds; flowers of sulphur, 15 pounds; common salt, 10 pounds; water enough to make 50 gallons.

92. What is said of kerosene preparations?

They should be applied to plants with great caution, but they are very efficient in fighting certain injurious insects.

93. How is kerosene emulsion made?

Dissolve one-half pound of naptha soap in one gallon of water, add two gallons of kerosene and thoroughly mix. Dilute by adding water. Use for scale and other sucking insects that can not be destroyed by the use of poisons.

94. What is Paris green used for?

It is a standard poison for all insects that bite and swallow their food.

95. What caution is needed in using it?

It needs constant stirring to keep the poison from settling in the vessel.

96. How is it mixed?

It is used at the rate of about 4 ounces to 50 gallons of water and some lime is often added to prevent harm to the foliage.

97. What is arsenate of lead?

It is often used instead of Paris green, because it is lighter and so remains suspended better. It also adheres to the foliage better.

WEEDS

1. What is a weed?

Any plant growing out of place or where it is not wanted is a weed. Rye growing in a wheat field or wheat growing in a field of corn is an injury to the crop and may be regarded as a weed.

2. How are weeds harmful?

In many ways. They use moisture and plant food needed by the crop, they shade and crowd out other plants, they increase the cost of tillage and harvesting and decrease the value of grain for market.

3. Can a farmer ignore weeds?

No farmer can make a success of his business until he learns how to fight weeds effectively.

4. How do weeds get into our fields?

Some weed seeds remain in the soil for several years and retain their vitality, some are carried by wind, by water, by birds, by animals, by machinery, or in seed grain or grass seed.

5. What is one essential in controlling weeds?

To know the common weeds and their habits and thus to take advantage of their weak points.

6. Are there a great many very troublesome weeds?

Not a great number, and it is not a difficult matter to know them both as seeds and as young or mature plants.

7. How great is the loss from weeds?

It is hard to estimate, but weeds cost many times as much as do all the schools of the country.

8. What are annual weeds?

Those that produce seeds in one year and die.

9. What are some of the annual weeds?

Pigeon grass, wild oats, wild barley, mustard, corn cockle, cocklebur, ragweed, etc.

10. Which is the most common?

Pigeon grass, or foxtail, which is very troublesome on poor soils and in cornfields after cultivation has ceased.

11. How shall one fight this pest?

It is well to plant rape, grain or clover just before the last cultivation of corn, and the growth of this crop will hold back the pigeon grass and other weeds.

12. How is mustard identified?

It has yellow blossoms with four petals and round black seed.

13. Where is mustard likely to be found?

It is very common in grain fields and it is very hard to get rid of.

14. Why is mustard hard to kill?

Because the seed will live for five years or more in the soil. If the main stem is cut off by binder or mower before the seeds are ripe, side branches grow out quickly and mature seed.

15. What is the best way to fight mustard?

By spraying with a three per cent solution of copper sulphate or a twenty per cent solution of iron sulphate before the mustard pods form.

16. What about wild oats?

They ripen earlier than most grain and the seeds fall to the ground, where they may live from two to four years and still grow.

17. Is it difficult to rid the fields of wild oats?

If they get a start in a field devoted to grain it is almost impossible to get them out unless the fields are put to corn, so that cultivation may kill them.

18. What is wild barley or squirrel-tail like?

This troublesome annual is a fine grass-like plant growing in bunches along roadsides and in old meadows and pastures. It has soft, drooping heads with long beards.

19. How may wild barley be eradicated?

By breaking up the field and planting corn two or three years and then reseeding to pasture or meadow.

20. Will a few weed seeds in seed grain do much harm?

Yes, if there are weed seeds in grain that cannot be cleaned out it should not be used, but clean seed should be procured.

21. What other rules may be suggested for keeping weeds off the farm?

Insisting that the threshing machine be well cleaned before it moves to the farm; never feeding stock troublesome weeds, as some seeds pass through undigested; preventing all weeds from seeding.

22. What effect has rotation of crops on weeds?

It is the best remedy for controlling annuals.

23. Will stock help to destroy weeds?

Yes, especially in stubble fields. Sheep are particularly helpful, as they eat many kinds of weeds and eat them so close to the ground that they cannot seed.

24. What other treatment may be given stubble fields?

Disking them soon after harvest kills many and covers others.

25. Are there any crops that are specially helpful in destroying weeds?

Quick-growing crops, like barley and millet, may be sown late, giving a chance to cultivate well before seeding. They grow thickly and ripen early, thus giving the weeds a poor chance.

26. What are biennial weeds?

They are those that grow from seed one year, live over winter, mature seed the second year, then die.

27. What are the most troublesome biennials?

Thistles and burdocks.

28. What are the kinds of thistles?

The bull thistle, or common thistle; the Canada thistle; and the sow or milk thistle. The last two are perennials.

29. Which most need to be guarded against?

The Canada and sow thistles are very bad. No farmers should allow the Canada thistle to get a start.

30. Where does the burdock grow?

The burdock is found in pastures, waste places, and along the roadside.

31. How is the burdock most easily identified?

By the nearly round bur with its many little spines which enable it to cling to clothing or the hair or wool of animals.

32. How may one eradicate biennials?

By preventing them from seeding. It is best to cut them off just below the ground with a spade to prevent branches from starting.

33. What are perennial weeds?

They grow both from seeds and from roots which remain in the ground over winter. Breaking up the roots and spreading the pieces is just planting so many new weeds, for every joint will grow.

34. What are the worst perennials?

Morning glory, curled dock, Canada thistle, and sow thistle.

35. Describe the curled dock.

It grows about two feet high from underground rootstalks and has long, narrow leaves. It is commonly found in low, moist places.

36. How is it best handled?

By good drainage, cultivation, and rotation of crops.

37. Why are morning glories a nuisance on the farm?

They twine about crop plants and choke them. These weeds spread by underground root stalks and ordinary cultivation and rotation will not kill them.

38. How may they be killed?

By persistent hoeing, so as to keep all leaves cut off, allowing none to appear above ground.

39. What distinguishes the sow thistle?

It is smooth leaved with yellow blossoms, and it sometimes practically takes possession of whole fields. Its seeds are blown about and it spreads easily, both in this way and by root stalks.

40. How does the Canada thistle spread?

In the same manner as the sow thistle.

41. What means are used to kill the Canada thistle?

Large stalks may be killed by cutting them off when in bloom. The stems are hollow and rain running down the hollow stems causes the roots to decay.

42. How may perennials be exterminated?

If the patch is small the roots may be dug up, or it may be smothered with tar paper, because no plant can live if the leaves are kept in the dark away from the sunlight.

43. How else may they be smothered?

By a thick covering of straw or manure.

THE ORCHARD

1. What is the most popular and widely-grown fruit?

The apple is most widely known and prized, but it does not cover so great a range of latitude as some others.

2. What are some of the leading apple states?

New York, Michigan, Pennsylvania, Missouri, Oregon, and Washington.

3. What soils does the apple require?

It thrives on a great variety of soils, but when planted in large areas for profit it becomes necessary to select those soils that give the best results.

4. What are some of the soil qualities desirable?

A deep soil of gravelly loam, rich in plant food, with porous subsoil free from hardpan. Apple trees cannot thrive in a poorly-drained soil.

5. How shall one select his nursery trees?

They should be free from obnoxious insects and fungous diseases. The Government inspection is not always a sufficient guarantee of this.

6. What slope is most desirable for fruit?

   The north slope and east slope are generally considered best because they are shielded from the warm sun. The trees therefore do not blossom so early and are less liable to be caught by late frosts.

7. What may be said in favor of a south slope?

   Fruit on the south slope has a deeper color, though it is usually smaller than that grown on the north slope because the south slope is drier from evaporation.

8. What soil preparation is necessary for a fruit orchard?

   The soil preparation should be made as carefully for fruit as for a corn crop, so that the roots of the trees may grow far and wide for food.

9. What is required as to drainage?

   Thorough drainage must be provided because an orchard should not be too wet.

10. Shall one import trees?

    No, they should be purchased as near home as possible, so they will be accustomed to the climate.

11. What season is proper for planting?

    Trees may be planted either in the fall or spring.

12. What rule may be given for the distance between trees?

    It is common practice to plant apples 30 to 40 feet apart each way; pears, 20 to 30 feet; quinces, 10 to 12 feet; plums, 15 to 20 feet; sweet cherries, 15 to 25 feet; and peaches, 15 to 20 feet apart each way.

13. What advantage is there in straight rows?

Straight rows not only improve the appearance of an orchard, but they make tillage easier.

14. What is the reason for pruning the tops of nursery stock?

Many of the roots have been destroyed in transplanting, so the tops should be cut back proportionately that there may not be a shortage of food. If the top is left there will be greater demand for plant food than the roots can supply.

15. How large a hole is needed for planting?

The hole must be large enough to accommodate the roots in their natural position. They should not be bent or crowded together.

16. How should the soil be arranged about the tree?

The soil must be packed firmly about the roots, so they can begin to draw plant food at once.

17. What directions are given about the surface?

The surface of the soil about the tree should be loose to act as a mulch to prevent evaporation.

18. What is a common mistake in planting trees?

Leaving the soil about the roots loose and packing the surface hard.

19. Why is this bad practice?

It is favorable to the evaporation of the moisture needed by the plants, and the drying of the soil kills the young tree.

20. Why is tillage of an orchard advisable?

Tillage improves the soil. saves moisture, and sets free plant food.

21. What proportion of fruit is water?

More than ninety per cent of most fruit is water.

22. Is it wise to grow any other crop in the orchard?

Trees make a heavy demand on plant food, and unless the soil is very rich it is unwise to grow any other crop.

23. What fertilizer may an orchard need?

It needs humus, which may be supplied by barnyard manure. It may need nitrogen, phosphoric acid, and potash.

24. What are the purposes of pruning?

To give the tree an attractive shape and to keep limbs from interfering with one another. Also to provide air and light for all parts of the tree.

25. What different effects have winter and summer pruning?

Winter pruning encourages the growth of wood, while summer pruning encourages the production of fruit.

26. Upon what does the market price of fruit largely depend?

Upon how well the fruit is graded and how attractively it is packed.

27. What is meant by grading fruit?

When they are separated into piles of like sizes and packed separately.

28. Why is the peach harder to grow than the apple?

Because it is more easily injured by frost.

CORN

1. What effect would a more careful selection of seed corn have upon the crop?

It is believed that by more scientific selection of seed the crop in any state in the Union could be made to yield from five to twenty bushels per acre more than it now yields.

2. Is judging corn a difficult lesson to learn?

By no means. By learning the desirable points of a good ear a little experience will make one a proficient corn judge.

3. How may one select a well developed ear?

Only the best developed ears are filled out at the tips.

4. What kind of kernels are desirable?

Uniform and rectangular kernels.

5. How are such kernels secured?

By selecting only ears with straight rows and by discarding the kernels at both tip and butt.

6. Why do we wish all kernels to be uniform in size and shape?

Because most farmers plant with a machine and wish to plant three kernels in a hill. If the kernels are irregular in size and shape the machine will not plant evenly.

7. Why is it desirable to plant large kernels?

   The larger kernel contains a larger amount of food material to sustain the early growth and thus a more vigorous plant results.

8. Can one tell by looking at an ear of corn whether or not the kernels will sprout?

   No, the only way is to test it. If the farmer takes ten kernels from one ear and they all sprout it is a good ear for seed.

9. What is a corn grader?

   Graders are machines that sift out the small grains or kernels that grow on the tips of the cob and the large, irregular ones that grow on the butt.

10. Is it advisable for a farmer to own one?

    A corn grader costs about $10, and it will soon pay for itself if the farmer plants fair-sized corn crops.

11. What land is best fitted for corn?

    Land that grew clover, alfalfa, cow peas or grass the preceding year.

12. Why is clover or grassland best for corn?

    Because it has much vegetable matter left in the soil and this is good for the crop.

13. If there is neither clover nor grassland to be had for corn, what then?

    Choose well-drained land, manure heavily, and disk it in well.

14. When is the best time to plow for corn?

    Usually in the fall.

15. What treatment should fall-plowed land have in the spring?

It should be thoroughly disked before planting to corn.

16. How early should one plant?

As a rule, corn is planted in May as early as the soil can well be prepared.

17. Is it desirable to plant earlier in wet soil?

No, because the corn will not sprout in cold, wet soil, but will rot.

18. What is the most common mistake in planting corn?

Planting too deep. Corn cannot be made to root deep by planting deep.

19. What are some of the reasons for cultivating?

Keeping down weeds, preventing evaporation, and furnishing air to the soil.

20. How do corn roots grow?

In a dry soil corn roots will grow nearly straight down while in a heavy or more moist soil they spread out near the surface of the ground.

21. How deep shall one cultivate?

Shallow cultivation is usually best, for one should not break off the roots that are feeding the plant.

22. Which is better—a cultivator, with two or several shovels?

A cultivator with four or five small shovels on a side is better unless the corn is very weedy, in which case larger shovels will better destroy the weeds.

23. What device is often better than shovels, especially for weeds?

In place of shovels two or more knives or blades that run an inch or two below the surface, separating the surface soil and cutting the weeds.

24. What advantage has the check planter?

In weedy soil it enables the farmer to cultivate both ways and destroy all weeds.

25. What is the best method of securing seed corn?

A farmer will get the best results by selecting the seed from his own farm.

26. Is there any variety adapted to all latitudes?

No, each section, even each locality, has varieties that have adapted themselves to that particular region and it is unwise to import seed corn from a distance.

27. How may one develop an early variety?

By selecting for seed, year after year, the ears that ripen first.

28. Shall one select seed from a load of husked corn or from the bin?

It is better to select seed corn in the field, because the stalks must be considered as well as the ear. Usually good ears come from good plants, but a good ear that comes from a stalk that bears two ears is to be preferred for seed.

29. What are qualities to look for in the ear?

The ear must be firm and solid to the touch and the kernels should not be loose on the cob. Loose kernels

indicate immature ears and these do not germinate readily. The rows on the cob need to be straight and the kernels flat, as round grains leave space of cob uncovered. The tips should be well filled out.

30. Why should seed corn be dried before cold weather?

Because if corn is not thoroughly dry, freezing injures the seed germ.

31. How may seed be treated in order to dry well?

It should be stored in a room so the air may circulate about it freely. Often the heat of a stove or furnace is used to assist in the drying operation.

32. What good storage place is suggested?

In the attic over the kitchen with windows open.

33. Why is the loft over the stable, where stock is kept, a poor place for seed corn?

Because the steam and breath from the animals will keep the corn moist enough to greatly reduce its vitality.

34. Is it wise to leave seed corn in a pile?

It should not be piled over eight or ten inches deep, as it hinders a free circulation of air about it.

35. What are some of the devices used in drying corn?

Some use the "corn tree," which is merely an upright post with headless nails slightly driven in. An ear of corn is easily stuck on each nail by jamming it into the pith at the butt of the ear. This holds it horizontally apart from the other ears. Other farmers use a wall thickly driven with nails.

36. What portion of the world's corn crop is produced in America?

Over three-fourths is grown in the United States. Nearly half the world's crop is grown in the Corn Belt: Illinois, Iowa, Nebraska, Missouri, Kansas, Indiana, and Ohio.

37. How does a full crop of corn compare in food value with a crop of other grains?

A full crop of corn may produce twice the amount of food furnished by other grains.

38. What was the Indian method of planting corn?

They planted four grains in a hill four feet each way and taught this method to the early colonists.

39. At what distance is corn generally planted now?

Most of the corn in the Corn Belt is planted three feet eight inches apart each way, with two to four kernels per hill.

40. Does it pay to own a corn harvester?

They are very convenient, but not profitable unless one has a considerable area to cut.

41. What is the more general way of harvesting corn?

More corn is husked from the standing stalks in the fields than is harvested in any other way.

42. Are silos in general use in the United States?

They have come into common use in the dairy sections in the past fifteen years.

43. What advantage comes from the use of the silo?

It prevents much of the loss of food and makes both

the feed and the manure easier to handle. Silage or ensilage is more palatable than fodder and stock will eat more of it.

44. How does silage compare with fodder for milk production?

The same amount of corn in the silo will produce more milk than it will if fed as fodder, and as silage it is all eaten by the cows.

45. By what principle is the food preserved green in the silo?

The principle is the same as that of canning fruit. The silage heats very hot and begins to decay, which uses up the air in the silo, changing it to carbon dioxide. When the air in the silo is exhausted the decay ceases and the bacteria die. The silage will then keep indefinitely, provided no more air can get in.

46. What is the best building material for a silo?

Any kind of material may be used; cement, stone, or brick; but they are all more expensive than wood.

47. What is the chief essential?

That the silo be air-tight at the sides and bottom. The deeper the silo the cheaper the construction for a given capacity and the better the silage keeps, because that in the bottom is packed harder.

48. When should corn be cut for the silo?

When the kernels are glazed and the lower leaves have begun to die.

49. For what animals is silage used as a feed?

Its chief use is for feeding dairy animals. Though it is good for sheep and fattening cattle, it is not often so used. It is not fed to horses.

50. Is there reason in the prejudice against silage milk?

No, if the silage is in good condition there is no unpleasant flavor in the milk, and the user in many cases prefers the silage milk.

51. To what different uses is corn put?

The chief use of corn is as food for farm animals; a large amount is used as human food; it is also made into alcohol, whiskey, glucose, cornstarch, and corn oil.

52. How much pork will a bushel of corn produce?

From ten to eleven pounds of pork may be produced from a bushel of corn.

53. What proportion of the American corn crop is exported?

Less than two per cent is exported.

WHEAT

1. Why is the price of wheat higher than that of other grains?

Because it is more highly valued as human food than are the other grains.

2. Are the food elements of wheat superior to that of other grains?

No, chemically wheat does not seem to be superior, but it has certain elements that make it more palatable and healthful.

3. How does the wheat crop of North America compare with that of Europe?

   Europe produces twice as much wheat as North America.

4. How can Europe compete with America in the world's market?

   Europe secures about twice the yield per acre, and so is able to compete with the great wheat farms of our country.

5. What is the difference between wheat adapted to humid regions and that of drier regions?

   The wheat of humid regions is a soft variety, while that of drier climates is hard.

6. What makes possible the "bonanza" wheat farms?

   Wheat lends itself to machine-farming better than most other crops, and this makes very large farms profitable.

7. Why does wheat thrive farther north than corn?

   It is better adapted to short seasons and completes its growth before the severest summer droughts occur. A drought late in summer is injurious to corn.

8. What soils are well adapted to wheat growing?

   Wheat will grow on a variety of soils, but does best on clay loams and clays. These are not the best soils for corn.

9. Which is the better paying crop, wheat or corn, when the land is suitable to either?

   The corn crop is more profitable.

10. How much wheat is sown to the acre?

    From six to eight pecks.

11. What uses has wheat other than the flour used in making bread?

    Breakfast foods, paste, starch, and macaroni and food for animals.

POTATOES

1. Whence came the potato?

   It is a native of South America and was carried to Europe by the early explorers.

2. Why is it sometimes called the Irish potato?

   It was early introduced into Ireland, where it became the staple food plant. Great famines resulted there from potato crop failure.

3. What is the part of the plant that we eat called?

   A tuber.

4. What is a tuber?

   A root plant like the carrot is a development of the root, but the potato is not a root: it is an enlarged underground stem called a tuber.

5. Are rootlets ever attached to the potato tuber?

   No, rootlets grow from other roots and the tuber is not a root.

6. Why should a fair-sized piece of the potato be left with the "eye" when planted?

   The young plant must have food to sustain it until it can send its roots down and its leaves into the sunlight.

7. How deep are the seedpieces planted?

   From two to five inches, according to the soil.

8. Why do not some growers hill up their plants?

   Level culture wastes less moisture by evaporation than does hilling.

9. When should potatoes be harvested?

   The early ones should be dug as soon as they are large enough for market. Late varieties are left until the vines are dead and dug when the ground is dry.

10. What is the average yield in the United States?

    About eighty-five bushels to the acre. Under ideal conditions from three hundred to five hundred bushels to the acre is not uncommon.

11. What are the early enemies of the potato plant?

    The first enemies are the fleabeetles, which appear as soon as the plant is above ground.

12. How are they checked?

    By spraying with Paris green, combined with the Bordeaux mixture.

13. How may one identify the Colorado potato beetle?

    It has a black and yellow coat when mature.

14. How is it checked?

    By the same means as the fleabeetles.

15. What diseases often check the growing crop?

The early blight usually appears in June. The late blight is more serious.

16. How is blight checked?

By spraying with the Bordeaux mixture.

17. How may the potato scab be prevented?

By soaking the seed potatoes in a three per cent solution of formaldehyde for one or two hours.

18. What are the uses of the potato?

It is used largely for human food, but it is good food for stock, either raw or cooked.

19. How does the potato crop compare with grain or hay as to labor?

It requires a greater amount of labor per acre, and, as a rule, yields a much larger income.

20. How do they compare in cost of production?

It costs about $25 an acre to produce potatoes; about $9 per acre for wheat, and about $7 for hay.

21. What are some of the difficulties in raising potatoes?

They are a bulky crop and expensive to market, especially if it is a long haul to the station.

22. Compare the keeping qualities of potatoes with grain.

Potatoes are a perishable crop and cannot be held over for high prices as can grain or hay. Potatoes must be protected from the cold in winter.

23. What effect have potatoes on the soil?

About the same effect as corn. By thorough cultivation they give an opportunity to destroy weeds, to

conserve moisture, and to aid the decay of vegetable matter in the soil.

24. How may the best prices be obtained by the farmer for potatoes?

It is better to raise one variety in large quantities than several varieties, so as to ship in unmixed carload lots.

25. How can farmers coöperate in raising potatoes?

The farmers in one locality could well choose one or two varieties that suit their soil and all raise these same varieties so as to ship together in unmixed carloads.

26. When is the time to select seed potatoes?

In the fall, when the crop is being dug, if one wishes to improve the variety; otherwise it tends to run out.

27. What is a guide in selecting seed?

Select only from hills that yield from five to eight good-sized potatoes, of even size, discarding those hills that have any very large or very small potatoes in them.

28. Why not simply select seed from the bin?

Because the good-looking potato chosen from the bin may have grown on a plant that had many other small ones, and the tendency of the seed is to produce like the parent plant.

29. How many seed potatoes are required per acre?

About ten bushels.

30. How does sprouting injure seed potatoes?

It uses up part of the food stored for the young plant and leaves the seed less vigorous.

31. Why can a farmer afford to spend more time preparing an acre of ground for potatoes than for grain?

Because a fair crop of potatoes should net $40 per acre, while grain is worth about $10 per acre.

32. Why should potatoes be planted early?

They should be planted in April or early May, so they will have a chance to grow before the dry hot weather comes.

33. How long should cultivation continue?

Until the vines cover the ground in order to keep down weeds and check evaporation.

COTTON

1. Whence came the cotton plant?

It was cultivated in the Old World in the earliest historic times. It was also cultivated in Mexico and South America before Columbus discovered this continent.

2. When was cotton introduced into the American colonies?

The colony of Virginia first began cotton culture in 1621.

3. How did the invention of the cotton gin help the cotton industry of the world?

It greatly increased the profits of cotton raising.

4. What is the chief cotton-growing country?

Nearly two-thirds of the world's crop is grown in twelve of our Southern states.

5. What other countries produce large amounts?

India, Egypt, Russia, China, Brazil, Mexico, Peru, Persia, and Turkey.

6. What may be said of the importance of the cotton plant?

Cotton is by far the most important fiber crop of the world.

7. How is thread woven from cotton fiber?

The fibers of the common cotton are only about an inch long, but they become crooked and wavy as they ripen, and this causes them to cling together well to form thread when put through the spinning process.

8. What are the different types of cotton?

The cotton grown in this country is chiefly of three kinds: Common or short-staple upland cotton, long-staple upland, and sea-island cotton.

9. Why is sea-island cotton so called?

It originated in the West India islands. It grows well on islands and on the mainland within one hundred miles of the coast.

10. What makes the sea-island cotton valuable?

The fibers are long and of value in making spool cotton thread.

11. How may cotton growers improve their cotton?

By selecting seed from heavy yielding plants.

12. How else may the yield be increased?

By proper fertilizer, good rotations, and early planting.

13. When is the best time to select the seed?

Just before and during the second picking; bolls should be selected from thrifty plants with compact growth of branches.

14. Why should the soil for cotton be deep?

The plant has a tap root and is a deep feeder.

15. What bearing has this tap root upon drainage?

It makes good drainage necessary.

16. How may the soil be kept up where cotton is grown year after year on the same fields?

It is then well to grow a crop of green manure between the rows to be plowed under in the fall or the next spring. Such crops might be cowpeas, peanuts or soy beans.

17. Why is it bad practice to burn the stalks?

The soil needs them to replace the humus taken out by the crop.

18. How then may the stalks be disposed of?

They should be cut up with a stalk cutter or broken to pieces and plowed under.

19. What is the best method of keeping up the fertility of cotton fields?

The cottonseeds or their equivalent should be returned to the soil. The best method is to feed the seed to stock and scatter the stable manure over the field.

20. How much fertilizer may be substituted for each one hundred pounds of cottonseed?

Three pounds of nitrogen, one pound of phosphoric acid and one and one-fourth pounds of potash.

21. What is the best method of supplying the nitrogen?

Growing legumes and plowing them under as green manure.

22. What element are cotton fields likely to need?

Phosphoric acid.

23. What is the planting time?

About two weeks after the last killing frost.

24. What distance is allowed between the plants?

The rows are from three and one-half to four feet apart and the plants twelve to eighteen inches apart.

25. How much seed is allowed per acre?

From one to one and one-half bushels per acre to insure a good stand of plants.

26. What cultivation is needful?

The cultivation should be frequent and shallow until about time for picking to begin. A crust should not even then be allowed to form.

27. What is a good yield of cotton?

The most productive fields will grow two bales per acre, but the average of the cotton belt is only two hundred pounds, or two-fifths of a bale, per acre.

28. What good is being done by Government demonstration farms?

The cotton yield in Louisiana, due to United States

demonstration methods, was increased from three hundred and eighty to seven hundred and sixty pounds per acre, all of which resulted from using better methods in cotton production.

29. What mistake is sometimes made in storing the bales of cotton?

The bales are too often exposed to the weather without shelter for months, and this may darken and weaken the outer layers and lower the selling price of the entire bale.

30. What are some by-products of cotton?

The chief by-product is cottonseed oil, extracted from the seed. The oil is used in making salad oils, cottolene, oleomargarine, soaps and other articles. The part left after the oil is taken out is ground into meal and fed to stock, chiefly dairy cows.

31. From what diseases may the cotton crop suffer?

From cotton wilt, cotton rust, and cotton root knot, all of which may be avoided by a proper rotation with corn, wheat, and legumes.

32. What are the insect enemies of cotton?

Two insects, the bollweevil and the bollworm, do most of the harm to the cotton crop.

33. How may the grower best guard against the ravages of the weevils?

By forcing the crop to mature early.

34. How may early maturity be hastened?

(a) Preparing the soil early and thoroughly.

(b) Planting early, using plenty of seed.
(c) Cultivating often during the growing season.
(d) Growing such varieties as set bolls early.
(e) Selecting seed from early-maturing plants.
(f) Using plenty of phosphoric acid as fertilizer.

35. What other precautions are advisable?

Picking the cotton as early as possible and immediately destroying the entire field of plants, so as to starve the weevils several weeks before the cold weather drives them into winter quarters among rubbish.

TIMOTHY HAY

1. How did timothy get its name?

From Timothy Hansen, who took it from New York to the Carolinas about 1720.

2. Why is timothy a popular crop?

The seed is cheap, the crop is easily and cheaply grown, it stands well, it cures quickly, it loses but little in handling, it produces a good crop the year after it is sown, and it is well adapted to growth in rotation with other crops.

3. What kind of soil is suited to the raising of timothy?

It grows well on clay, clay loam, loam, and even on sandy soils; but it grows best on clay loam.

4. What is the minimum or smallest amount of timothy sown to the acre?

Nine pounds. Eleven pounds is the usual amount sown with cereals and fifteen pounds when sown alone.

5. About how many seeds in nine pounds of timothy seed?

   About ten million, or two hundred for each square foot in the acre.

6. Do most of these seeds grow?

   No, some never sprout, some die because not well covered, and some are crowded out by more vigorous neighbors.

7. Is it necessary to have a finely pulverized seed bed for grasses?

   Very necessary, unless one wishes to waste a great deal of seed. The better the seed bed is prepared the less seed need be sown.

8. Is it necessary to cover grass seed at all?

   Much seed is sown without covering, which is all very well in continued rainy weather. Probably in well prepared soil deeper covering would bring a better stand, because many sprouting seeds die from the surface soil drying out before the roots get a deeper hold.

9. Why is it best to sow grasses with fall crops?

   Because the seed sprouts better then and because fall crops are harvested earlier in the spring, thus giving the grass a better chance.

10. Under what conditions is spring seeding of grass better?

In places where the autumn rainfall is very light and the soil dry, it is better to sow in the spring.

11. How deep should grass seed be sown?

Grass seed needs shallower covering than cereals because the grass seed contains less starch to feed the plant until it gets its leaves into the sunlight.

12. How long should the average field remain in timothy?

Two or three years will give the highest hay yields and also give the soil its best power for producing other crops.

13. What fertilizer is best for this crop?

Manures rich in nitrogen give best returns in grass.

14. Into what rotations of crops does timothy fit?

The most common rotation in the North Atlantic and North Central States is: maize, oats, and wheat, each for one year, followed by timothy and clover for two or more years.

15. When should timothy be cut?

If intended for market, it will weigh most when nearly ripe, but for feeding it is best cut when the seed is in the dough.

16. How does timothy compare with grains for feed?

Timothy is low in muscle-making protein and fat and high in carbohydrates and indigestible fiber. It makes better feed for horses than for cows.

17. Do animals get all the food value from hay, straw, and grain?

No, only from forty to fifty per cent of the food in

straw; fifty to sixty-five of that in hay; and seventy-five to ninety of that in grain.

18. Why is the net value of hay so much less than that of grains?

Because it contains a far less amount of food and because a larger proportion of the energy of the food is used up in masticating and digesting it.

19. Is this energy used a dead loss?

No. It generates heat and helps to keep the animal warm.

20. When should timothy hay and straw be fed?

For wintering mature animals.

21. When is it a mistake to feed timothy hay or straw alone?

They should not be used alone to feed to working animals, to growing stock, or to milch cows.

22. What are the disadvantages of timothy hay compared with other hay?

It produces but one crop a year; it grows very little for several weeks after it is harvested, and thus if the weather be hot and dry many plants are injured; it is slow to start in the spring; and it does not produce a dense sod.

23. How much seed may be raised per acre?

Timothy produces from four hundred to five hundred pounds of seed per acre.

24. What is the weight of a bushel of timothy seed?

The seed weighs forty-five pounds per bushel.

25. Is timothy used for anything else than hay?

It is used in nearly all pasture mixtures.

26. Does it hold well in pasture?

No. It gives place to other grasses in a few years.

27. Is timothy a good milk producer?

No. It is a very poor food for cows. Clover is more than twice as valuable for milch cows, and alfalfa is still better.

LEGUMES

1. What are the chief leguminous crops?

The chief legumes are clover, alfalfa, soy bean, cowpea, velvet bean, and vetch.

2. What makes legumes a highly desirable food for stock?

They contain a relatively high percentage of protein.

3. Why is a leguminous crop good for the soil?

Because these plants have upon their roots innumerable nodules in which live bacteria which gather a great deal of nitrogen from the air. Much of this nitrogen is left stored in the roots, and later crops feed upon it.

4. Why is this deposit of nitrogen in the soil desirable?

Because all crops need nitrogen in order to mature, and they cannot take this nitrogen direct from the air, but are only able to take it from the soil.

5. Sometimes it is difficult to get a stand of alfalfa, soy bean, or even clover. What is the difficulty?

The soil may be deficient in the bacteria needed by the plant.

6. What is the remedy?

Over each acre of the new field scatter one hundred pounds or more of soil from a field where the crop has grown and this will give the needed bacteria. This process is called inoculation.

7. Is there no other way of starting alfalfa, clover, and the like on new soil?

Sometimes a heavy coating of manure and lime will give the legume a hold. Repeated sowing of the same crop will enable the right bacteria to develop in the soil until it will grow a good crop.

8. What is the best way to inoculate a new field with soil from the old?

After the new field is plowed scatter a hundred pounds or more per acre of the soil from a field containing the right bacteria and harrow it in at once before the bacteria are killed by drying and sunlight.

9. Can one expect the bacteria of a clover field to give a start to alfalfa or soy bean or other legume?

No. Each legume has its peculiar bacteria and unless the legumes are closely related inoculation is often necessary.

10. Why do legumes make good food for stock?

Because they help to make a balanced ration. Farmers who give no heed to balancing rations lose money.

11. How is this explained?

The great bulk of grain and roughage which is used for stock feed contains an abundance of starch and other heat-forming substance, but is deficient in protein, or muscle-forming foods. Both the whole plant of legumes, as well as the seed, contain a high percentage of protein, which balances the starch and fats of other foods.

12. Do human beings need a balanced ration, too?

Yes. Men eat meat to balance the starchy potatoes, just as growing cattle need clover or alfalfa or cowpea hay to balance the grain or stover of maize. If any animal can not secure a balanced feed it overtaxes its digestion in an effort to secure the missing elements.

13. What is the chief element of food furnished by the legume?

It is nitrogen. A ton of alfalfa, clover, or cowpea hay contains more nitrogen than a ton of timothy, or fodder; it contains more nitrogen than a ton of corn or oats.

14. Is manure formed from legumes particularly valuable?

Since nitrogen is the most expensive of commercial fertilizers, manure produced from legumes, being rich in nitrogen, is more valuable than that from other feed.

15. Why do legumes leave the soil in better condition than grains?

Legumes leave in and on the soil a larger quantity of vegetation than do cereals, and this organic matter

contains relatively a great quantity of nitrogen, phosphoric acid, and potash, which become valuable for other crops with the decay of the vegetation.

16. Do not grass crops leave behind a large quantity of vegetation in the form of roots, stems, and the like?

Yes, but this vegetation is not so rich in nitrogen, phosphorus and potash as is that of legumes.

17. How do the roots of legumes compare with grasses?

The roots of red clover and alfalfa are much longer, from six to ten feet, and often extend far down when the soil will permit.

18. What advantage comes from the deeper root habits of most legumes?

They not only secure food from lower depths, but leave a part of it near the surface to feed shallower-rooted crops.

19. How does the organic matter left by the crop improve drainage?

The long tap roots of red clover and alfalfa, decaying, leave openings for the passage of water and thus assist drainage.

20. How does the decay of large amounts of vegetable matter near the surface improve the physical condition of the soil?

It makes the surface looser and more porous and so enables more water to enter instead of running off on the surface, and it also enables the soil to hold more water, which is needed in abundance by plants.

RED CLOVER

1. What other names has red clover?

   It is known as common clover, June clover, meadow clover, broad-leafed clover, and meadow trefoil.

2. To what depth do the roots extend?

   The tap root, which often forks into two or more branches, sometimes extends more than six feet into the ground, but their usual length is about two feet.

3. Do all clover roots extend straight down?

   No, the secondary roots, which are numerous, arise from the upper third of the tap root and spread through the surface soil.

4. Can clover withstand a drought?

   The long tap root reaches moisture beyond the danger from the ordinary drought.

5. Is red clover seed often adulterated?

   Not often. Of twenty-eight samples examined by the Ohio station only one was below ninety-three per cent pure. Standard purity should be ninety-eight per cent or more.

6. How old may red clover seed be and still be safe?

   It seems unwise to use seed over three years old.

7. How widely distributed is the clover crop?

   It is grown throughout the United States and Canada east of the hundredth meridian and north of the Gulf States, on the Pacific coast, and in many foreign countries of temperate climate.

8. How long does the red clover plant live?

   By some it is called a biennial, by others a perennial of a few years' duration.

9. How does its life compare with timothy?

   When timothy and clover are grown together it is usual for the first crop to be largely clover, the second year about half and half, the third year largely, if not quite wholly, timothy.

10. To what climate is red clover adapted?

    It is adapted to a temperate climate. It will not stand as much cold and moisture as alsike clover, nor as much heat and drought as alfalfa.

11. Will it grow on all soils?

    On all but the poorest if the rainfall is ample, but it is best adapted to well-drained loams.

12. If clover will not grow where it formerly grew, what assistance is needed?

    Apply a generous coat of stable manure and lime, the manure to hold moisture for early growth and the lime to furnish proper conditions for the growth of the nodules of bacteria.

13. When is the best time to sow clover seed?

    It may be sown at any time during the growing season but early spring sowing gives the best results.

14. What dangers must be avoided?

    The young plants may be killed by a sharp freeze or by a few days dry spell; but as drought is more to be feared than freezing, it is best to sow early.

15. Should the seed of clover be covered?

Yes, by a light covering of soil whether secured by harrowing or rolling.

16. Is it wise to sow on a late snow?

Yes, because the seed sink into the liquid mud produced by the melting snow.

17. How may clover seed be sown late on fall grain crops?

When the clover seed is sown on fall grains it may be harrowed in without injury to the grain. This is especially desirable on heavy clays and soils lacking in organic matter.

18. Is harrowing needed on loam soils?

No, on loams rich in organic matter, rolling is all that is needed to cover the clover seed.

19. What are the objections to seeding with spring grain using seeder attached to grain drills?

This is often done with good results or the clover may be seeded after the grain by use of a wheelbarrow seeder.

20. How much red clover seed should be sown?

Ten pounds to the acre or eighty-five seeds a square foot is about the average when sown alone, but many farmers use twice this amount.

21. How much is used when sown with timothy or other grasses?

From six to eight pounds will give good results.

22. What are the causes of failure in red clover?

The difficulty may be one of several. It may be

fungous diseases or insect enemies or lack of a plant food such as potash; or the soil may be acid or it may be lacking in the nitrogen-gathering bacteria.

23. What is the best time to harvest red clover?

Most authorities agree that the best time is when one-third of the heads have just begun to turn brown.

24. Why is curing red clover more difficult than curing grasses?

For the first crop the weather is liable to be unfavorable; the plant contains a higher percentage of water, which requires time to evaporate; clover absorbs rain more readily than timothy when placed in piles. The leaves and heads are more likely to become dusty when rained upon or when improperly cured.

25. How is it cured?

No specific directions can be given. Much sunshine is necessary; it must not be rained upon; it should be turned in order to cure quickly; and it should not be handled too much.

26. When should clover be cut for seed?

The crop should be cut when the flower heads are in the main brown or black and the seeds mostly hard.

27. Why is the second crop best for seed?

The second crop seeds more abundantly because the bumblebees have become numerous and they cross-fertilize the crop. The second crop is also less likely to fall down because it does not grow so luxuriantly.

28. What is the best use for clover hay?

Because it is high in nitrogen, it makes fine feed for milch cows and for growing animals, especially sheep.

29. Is clover hay good for horses?

No, because it is liable to be dusty and to give horses the heaves.

30. Which is better to restore the fertility of the soil, red or alsike clover?

Red clover adds more fertility because of the greater amount of organic matter left in and upon the soil and because of the greater depth of its tap root.

31. In what way is red clover better than alfalfa?

It grows readily with grasses and fits better into almost any plan of rotation.

32. Compare the value of plowing under a clover crop with a heavy coat of rich stable manure.

Starr's Experiment Station found in the two and one-half tons of red clover on one acre: 138 pounds of nitrogen, 152 pounds of potash, and 32 pounds phosphoric acid. A ton of rich manure may contain: 10 pounds of nitrogen, 8 pounds of potash, and 10 pounds phosphoric acid. Thus the clover on this one acre contained as much nitrogen as 13 tons of manure; as much potash as 20 tons of manure; and as much phosphoric acid as three tons of manure.

33. Compare red clover with timothy as a feed.

Clover hay contains three times as much protein as timothy. But if the feed ration already contains

sufficient protein for the needs of the animal then clover hay is no better than timothy. Most feeds are, however, short in protein, and clover helps to balance them.

34. When is clover superior to timothy?

For growing cattle and sheep and for milch cows and in all feed rations that lack protein.

ALFALFA

1. What is unusual about the root of the alfalfa plant?

It has a strong, deep-growing taproot which will have reached a depth of five feet in six months.

2. How deep is the taproot of alfalfa known to reach?

It is reported by one authority to have been found at a depth of forty-five feet. Another has reported a depth of more than a hundred feet.

3. What effect has the water table on alfalfa roots?

They will cease to grow when they reach the water table or water-soaked earth. Alfalfa refuses to grow in soil that is not well drained.

4. How many stems grow from one taproot?

Sometimes with old plants twenty or thirty stems arise from one crown.

5. How may alfalfa seed be distinguished from that of clover?

Alfalfa seed has a light olive-green color, while red clover seed is purple and yellow.

6. How many pounds of alfalfa seed to the bushel?

   Sixty pounds are sold for a bushel.

7. How is alfalfa seed sometimes adulterated?

   By mixing with it black medic seed imported from Europe. But this is now forbidden by law.

8. What is the most serious impurity of alfalfa?

   The dodder, of which there are three kinds.

9. What are the chief varieties of alfalfa?

   One of the two chief types has a dark green color, narrow leaves with red stems, and usually deep purple flowers; while the other has green stems and much lighter flowers.

10. Which is considered the better variety?

    The red-stem variety is leafier and earlier but a little less vigorous than the green stem variety.

11. What climate is best suited to this plant?

    Alfalfa is naturally adapted to a warm or a temperate climate, though the Grimm Alfalfa may be grown in colder latitudes.

12. Why is alfalfa drought-resisting?

    Because the long taproot reaches down to moist soil, however dry the surface soil.

13. What conditions hinder alfalfa growth?

    Excessive rainfall or poor drainage or an acid soil.

14. Will alfalfa spread over the soil like blue grass or white clover?

    Only slightly. Grasses may spread between alfalfa plants and reduce their growth.

15. What bearing does this have upon soil preparation for alfalfa?

It shows that the seed bed for alfalfa should be well pulverized and clean of weeds and weed seeds.

16. What crops may well precede alfalfa?

Any crop that secures thorough tillage, such as corn, or peas, or root crops.

17. What fertilizer is needed for alfalfa?

Twenty loads of good stable manure to the acre gives good results, in spite of the weed seeds thus scattered. On many soils in humid sections, lime should be used at the rate of one thousand pounds to three thousand pounds per acre.

18. How should manure and lime be applied in moist climates?

The manure may be spread during the winter or spring, followed by plowing. Then a week before seeding, the lime is spread and immediately worked into the soil with spring tooth or disk harrow. The soil is then worked to a fine seed bed by harrow and roller or drag.

19. Is the manure applied in the same way in dry climates?

No, because manure worked into the soil may cause it to dry out too rapidly. In dry soils it is better to top dress with manure after a stand has been secured.

20. Is lime needed in the West?

It is seldom needed west of the Missouri River.

21. Will manure and lime give a stand everywhere?

No. In soil moderately adapted to alfalfa it may be necessary in addition to the manure and lime to inoculate the soil per acre with from one hundred to four hundred pounds of soil from an alfalfa field so as to introduce the proper bacteria.

22. If the young alfalfa in three weeks lacks the proper green color, what is needed?

More nitrogen is needed and may be supplied by one hundred pounds of nitrate of soda to the acre.

23. When should the young crop be first cut?

If sown without grain or nurse crop it should be clipped well above the crown about July first. This will retard the growth of weeds and cause more alfalfa stems to branch off, thus shading the ground and securing a better yield.

24. How long may a field be left in this crop?

Alfalfa has been known to grow good crops continuously for fifteen years or more without re-seeding, but the best crops come the third and fourth years after seeding.

25. What rotations are recommended for alfalfa?

For humid climates maize one year; barley, with which alfalfa is seeded, one year; alfalfa four years. Others divide the farm into five fields and keep one-fifth of the farm in alfalfa all the time.

26. How much seed is sown per acre?

From fifteen to thirty pounds per acre. Thick

seeding is better because the crop stands better and the weeds are kept down.

27. When is the best time to sow?

In the month of April, though if the weather is favorable it may be sown any time during the growing season.

28. Why are poor results obtained by sowing with oats?

Because the seeding is apt to be done to suit the oats and not to suit the alfalfa.

29. How deep is the seeding?

The depth depends on the soil and climate, the drier the climate and the sandier the soil, the deeper the sowing. In most climates good results are had by sowing with seeder attached to a grain drill, dropping the seed just ahead of the hoes.

30. How is deeper sowing obtained?

By using the grain drill itself and mixing soil or bran with the seed to make it feed evenly and yet not use too much seed.

31. Is any nurse crop helpful to alfalfa?

It is seldom an advantage and may be a disadvantage if the plant food or moisture of the soil is low.

32. What is the best nurse crop for alfalfa?

Barley is better than oats because it takes less moisture from the young alfalfa and barley is cut earlier than oats.

33. What is the most injurious fungous disease of alfalfa?

The leaf spot.

34. What is the best remedy for it?

Mow the crop as soon as the disease is noticed.

35. What are the injurious insects?

The chief one is the grasshopper.

36. How may one fight this pest?

By plowing in the fall to bury the eggs and spring harrowing.

37. How many cuttings may be expected?

The number depends upon the climate and soil and the stage at which the crop is cut. Commonly there are from two to five, but in Arizona seven cuttings are known.

38. In humid climates when should the crop be cut?

When the lower leaves begin to turn yellow even though but few flowers have appeared, or perhaps none.

39. When is the crop cut in irrigated or dry climates?

When the alfalfa is coming into blossom.

40. What makes alfalfa hard to cure in humid climates?

Its juicy stems cure slowly, and if handled much with tedder, hay rake, and other tools many of the leaves, which are the best part of the hay, fall off.

41. When can alfalfa be teddered with least harm?

Just as soon as it has become wilted.

42. What is the best method of saving the crop in moist climates?

It should be raked and put into cocks when quite green.

43. What effect will rain have upon alfalfa in the cock?

Cocks are not greatly injured save where the hay touches the ground. If the weather is such that there is danger of moulding, the cocks must be spread out and rebuilt.

44. When is alfalfa made into silage?

When on account of the weather there is trouble in curing the last crop, it is sometimes mixed with corn in the silo, one load of alfalfa to two of corn, both being put through the cutter.

45. How does alfalfa compare with red clover in yield?

Alfalfa yields twice as much tonnage per acre annually as does clover.

46. How do these crops compare in digestible nutrients?

A pound of alfalfa contains more than twice the amount of digestible nutrients that is obtained from a pound of red clover.

47. Does alfalfa contain more or less nitrogen than clover?

Alfalfa contains nearly four times as much digestible nitrogen as does clover.

48. What stock is alfalfa good for?

It can be fed with good results to horses, cattle, sheep, hogs, and laying hens.

49. How will the introduction of alfalfa into the feed ration of milch cows and fattening cattle affect it?

It will greatly reduce the grain needed to balance the ration.

50. What other article of food is alfalfa similar to?

In composition and digestibility, alfalfa is quite similar to that of bran.

CATTLE

1. From where have the improved breeds of cattle come?

From western Europe, chiefly Great Britain.

2. How are cattle classified?

As beef breeds, dual or general-purpose breeds, and dairy breeds.

3. Are the beef breeds profitable for milk?

Some do not give enough milk for their calves. None except the Shorthorn gives enough to be considered profitable for dairy use.

4. What are the chief points about the beef breeds?

They have plump bodies of blocky appearance. The back is broad, the neck and legs short, and all quarters are quite thick.

5. Name the chief beef breeds.

(1) Shorthorns, including Polled Durham, (2) Hereford, (3) Aberdeen Angus, (4) Galloway.

6. Where did the Shorthorns originate?

In northeastern England. They are now very popular.

7. Why the name?

It was given to distinguish them from the long-horned cattle of England.

8. What are the Bates Shorthorns?

A branch so much inclined toward the dairy type as to be classed as general-purpose animals.

9. How do the Polled Durhams differ from Shorthorns?

"Polled" means hornless, which is their only characteristic difference from the Shorthorns.

10. What are the prevailing colors of Shorthorns?

Red, white, and roan.

11. Whence came the Herefords? (Pronounced Her′ford.)

They originated in Herefordshire, England, and were first brought to this country by Henry Clay.

12. What is the color?

Herefords are red with white faces and often some other white markings along the back and on the feet or tail.

13. How do they compare with Shorthorns?

The Herefords are more blocky and a little heavier.

14. What makes Herefords so popular?

They are well suited to grazing and fatten easily on the grassy plains of the West where they have been extensively mixed with native cattle. This crossing makes a hardy and profitable beef breed.

15. Are Polled Herefords more desirable?

Hornless cattle are always to be desired, for horned cattle often do each other and sometimes their keepers much harm.

16. What other names are given to Aberdeen Angus cattle?

The hornless are called Polled Angus, those with horns, "Doddies."

17. Describe the Aberdeen Angus?

They are black, sleek, short-legged, and plump, a little smaller than the Shorthorns.

18. What qualities make the Aberdeen Angus popular?

They are quiet and gentle, fatten easily, either on blue-grass pasture or in close feeding quarters; their beef is of the best quality, bringing the highest market price.

19. What is the appearance of the Galloway cattle?

They are black with shaggy hair, hornless, and have very short legs. The hair is so long and curly that their skins are used for making rugs.

20. What are the marked qualities of the Galloways?

They are hardy and can subsist on the poorest roughage or pasture. Their beef is of good quality, selling next to that of the Angus, but they respond rather too slowly to good feeding.

21. What are the chief general-purpose breeds?

Devon cattle, Red Polled, and Brown Swiss. Also the Bates family of Shorthorns.

22. Under what conditions are general-purpose cattle desirable?

They are popular with general farmers, because they are fair milkers and the calves are heavy enough to be sold as veal.

23. What is probably the best general-purpose breed?

The Red Polled. The cows give a good flow of rich milk and when dry fatten easily, while the steers are good beef animals.

24. What are the marked qualities of the Brown Swiss?

They come from Switzerland and are well suited to foraging for themselves, yet they respond well to good treatment and feeding.

25. What are the chief dairy breeds?

(1) The Jerseys for butter; (2) Guernseys for a good quality of cream; (3) Holsteins or Holstein-Friesians for market milk; (4) Ayrshires for cheese, home milk, and infant feeding.

26. Where did the Jersey cow originate?

On a small island by that name in the English Channel.

27. How was the breed kept pure?

By stringent laws against the importation of cattle. Any cattle imported to the island were slaughtered within twenty-four hours.

28. Why is this the most popular dairy breed in America?

Both because of the abundance and the richness of the milk, but especially the richness.

29. What are the markings of the Jersey?

Color, squirrel gray or fawn; nose, usually black or dark colored; the tongue and switch may be either black or white.

30. What is considered a high yield of butter for a Jersey?

"Loretta D." produced 330 pounds of butter in 120 days.

31. Where did the Guernsey originate?

On the Island of Guernsey in the English Channel.

32. How do they compare in yield with the Jersey?

They yield about the same amount of milk and butter, but the cream is smoother and the fat particles not so coarse as that of the Jersey.

33. What of the appearance of the Guernsey?

They are a little larger than the Jersey and more rugged in appearance with colors of red-and-white or fawn-and-white and a flesh-colored nose.

34. Whence come the Holstein-Friesian, commonly called Holstein?

From two provinces in Holland, for which they are named.

35. How are they identified?

They are much larger than the Jersey, and black and white in color.

36. What of the Holstein milk?

It is of fair quality but not rich in fat. Holsteins, however, are the heaviest milk producers of all cattle.

37. What is one of the best records?

"Colantha 4's Johanna" produced 27,432 pounds of milk and 1,164 pounds of butter in one year.

38. Under what conditions is this breed popular?

Among dairymen who sell milk in the markets of large cities and in cheese-making districts.

39. What peculiarity of Holstein milk makes it especially desirable for city delivery?

The fat particles are very fine and hence the cream does not rise quickly.

40. What makes the Ayrshire cow popular?

The same qualities as the Holsteins, an abundance of milk but not rich in fat.

41. What are the markings of the Ayrshire?

They are smaller than the Holstein, larger than the Jersey, with a color of red, brown, and white, often mixed.

42. Are there any peculiar qualities of Ayrshire milk?

It has much solid matter which denotes high food value and cheese-making qualities.

HORSES

1. Whence came the horses of America?

They were either imported or are offsprings of imported stock.

2. When were they first introduced?

Columbus brought some on his second voyage, others were brought by Cortés and De Soto and by French, Dutch, and English settlers.

3. Where did the Texas ponies originate?

They are probably descendants of horses abandoned by De Soto.

4. Has any distinct breed originated in America?

Yes, the saddle horses and trotters.

5. How many types of horses are there?

There are three: the draft type, the light horse type, and the dual or general-purpose breed.

6. What are the pure breed groups?

The draft breed, coach breeds, light breeds, and ponies.

7. What are the chief draft breeds?

Clydesdale, Percheron, English Shire, and Belgian.

8. What are the chief coach breeds?

Hackney, German and French coach, and the Cleveland Bay.

9. What are the chief light breeds?

Thoroughbred, American trotting horse, and American saddle horse.

10. What are the chief pony breeds?

The Welsh, Shetland, and Exmoor.

11. What are the qualities of the Percheron?

Percherons are docile, intelligent, active, heavy in weight and are steady pullers under loads. They have excellent feet and are the most popular breed in America.

12. How are the Clydesdales marked?

They usually have white markings on the legs and a strip of white on the face. The thick stout legs are heavily fringed below the knees with long, shaggy hair.

13. How do Clydesdales compare with Percherons?

The Clydes usually have smaller bodies and longer legs, which are supposed to allow more action.

14. Why are Clydes well suited to farm work?

Because of their strength, rapid walking gait, and gentle disposition.

15. What qualities mark the Belgian?

The Belgian is probably the heaviest of our draft breeds. His body is more blocky, the breast wider, and the neck thicker than the other draft breeds.

16. What are the chief qualities desired in coach horses?

They are large, with high-knee action and fine style; and they draw medium loads with moderate speed.

17. What distinguishes the American or Kentucky saddle horse?

They are quick in action, show good style, and may develop some speed if desired. Besides the walk, trot, and canter of other horses, they have also the running-walk, the slow pace, the fox trot, and the single-foot.

18. What is a mule?

It is a cross between a donkey and a horse.

19. What are the chief qualities of the mule?

Mules are faithful, reliable, quick in movement, and have wonderful endurance. The common idea that they are more treacherous and more apt to kick than a horse, does them an injustice.

20. What attention does a horse's feet need?

They should be carefully examined in case of lameness. The hoofs should be trimmed when overgrown and the shoes should be suited to the kind of work the horse is to do. Shoes should be regularly changed.

21. What other points need watching?

The shoulders should be watched in order to keep them from soreness. Bathing with salt water will protect the shoulders.

22. What is likely to be the trouble if a horse refuses corn on the cob?

Swollen gums.

23. What per cent of the horse's weight is muscle?

About forty per cent.

24. How are the muscles employed to produce motion?

They are attached to the bones and when they contract they cause the bones to which they are fastened to move.

25. Is horse power the cheapest power on the farm?

There is cheaper power for certain purposes. The gas engine is cheaper power, but it will not do all the work of the horse.

26. About what is the cost of horse labor on the farm?

Careful accounts place it at eight cents per hour, or eighty cents for a ten-hour day, when the horses are owned on the farm.

27. What does it cost to keep a work horse a year on the farm?

The United States Department of Agriculture and

the Minnesota Experiment Station by keeping accurate records on twenty-four Minnesota farms, show the average yearly cost to be $84.

28. What is the average number of hours of work a year for each horse?

About one thousand hours.

29. What elements enter into the cost of keeping a horse on the farm?

Feed, labor of caring for him, depreciation, interest on investment, shelter, shoeing, and depreciation and repair of harness.

30. How can horses be made to do double duty?

The farm work may be done with mares that raise colts, and at least a portion of the feed for the mares will be paid for in the value of the colt.

31. How else may the cost of horse labor be reduced?

By keeping fewer horses and occasionally hiring an extra horse for a few days.

32. How does diversified farming affect the cost of horse labor?

By distributing the need for horse labor over a longer season through diversified crops, fewer horses will be needed.

33. Can one economize by having cheap horses?

No, it is important to have good strong horses for it costs as much to feed a poor one as a good one.

34. Do farm tools enter into the horse question?

The poorer the implements the less a horse can do

in a day; therefore the more horses will be needed.

35. What is the greatest item of expense in keeping a horse?

Feed is the chief item of expense. The average cost of grain fed to a horse in a year is about $50.

36. For what purposes does a horse need food?

To maintain his body, to replace muscle broken down by work, and to supply the energy necessary to perform the work.

37. Shall we feed much roughage to a work horse?

A horse has but one stomach and that is not nearly so large as that of a cow, so he should be fed oftener than a cow, and on more concentrated food.

38. What is the favorite feed for the horse?

Oats and timothy hay.

39. What cheaper ration might be fed?

Corn and clover hay, if the hay is good, bright and well-cured. Poor, dusty clover hay is not good for horses.

40. Give three daily rations for a 1,200-pound horse at heavy work.

(1) 18 pounds oats and 14 pounds timothy hay; or (2) 15 pounds corn and 14 pounds clover hay, or (3) 10 pounds corn, 7 pounds bran, and 14 pounds timothy hay.

41. If a horse on one of the above rations is to stand idle a few days what change should be made?

The grain should be reduced considerably.

SHEEP

1. In what respect do sheep resemble cattle and differ from hogs?

   In the matter of diet: sheep can eat and thrive on roughage like cattle. Hogs have a comparatively small stomach and a greater proportion of their ration must be grain.

2. Why should most farms have sheep?

   Because they eat weeds, leaves, and shrubs, and thus help to keep the farm clean.

3. What are the chief types of sheep?

   There are two: the mutton type, blocky in form, which correspond to the beef type of cattle; and the wool type, which are lean and angular in form like the dairy cow.

4. What are the chief mutton breeds?

   They are the long-wooled Cotswold and Lincoln, and the medium-wooled Shropshire, Southdown, Hampshire, Oxford, and Dorset.

5. What are the wool breeds?

   The Merinos, of which there are three breeds: the American Merino, the Rambouillet (Ram-boo-ya′) or French Merino, and the Delaine Merino.

6. What are the chief merits of the Merinos?

   They are all hardy and good grazers and therefore are well suited to the large sheep farms of the West.

7. What advantage comes from their wrinkles?

The deeper and more numerous the wrinkles the greater the skin surface for the growth of wool.

8. What of the Merino wool?

It is very fine in quality and the fleece is much heavier than those of other breeds.

9. Is Merino mutton of value?

The mutton is not of good quality and none but the largest Merino sheep are killed for their mutton.

10. What is the weight of the fleece?

In some strains of Merinos the clip of wool may equal one-fourth and sometimes one-third that of the animal's gross weight.

11. What weight do the mutton breeds dress?

They dress out from fifty to sixty per cent of their live weight.

12. Why are sheep said to produce two crops a year?

They produce a crop of wool and a crop of lambs.

13. Will the wool crop pay their way?

In many cases it does, leaving the lamb crop as clear profit.

14. Are there any farm animals that require as little care as sheep?

No, sheep require comparatively little labor and special attention except during the lambing season.

15. How does the income of sheep compare with that of cows?

From five to seven sheep will bring in as much profit in a year as one cow and with less care or labor.

16. Do sheep need protection from cold?

They are so well protected by their wool that they need little or no protection from the cold.

17. What shelter, if any, is used?

A board or straw shed closed tight on three sides shelters them from rains and drafts.

18. Will such a shed do for the lambing season?

No, if the lambs come in cold weather. New-born lambs must not be chilled.

19. What difficulty do some farmers find in keeping sheep?

The difficulty of fencing them in with the same fences that will suffice for other stock.

20. How much more does a sheep fence cost than a cattle fence?

A cattle fence can be built for from twenty to twenty-five cents per rod, while a sheep fence may cost from forty-five to sixty cents per rod.

21. What makes a good winter feed for sheep?

The winter ration should include plenty of roughage such as clover hay, cut corn fodder, and oat straw. Sheep are fond of root crops and will eat plenty of sugar beets, mangels, or turnips.

HOGS

1. What is the origin of the present breeds of hogs?

They have been developed from the wild hogs of Europe and Asia.

2. What are the chief types?

There are two: the lard, or fat type and the bacon, or lean type.

3. What are the chief breeds of the fat type?

Poland-China, Berkshire, Chester-White, and Duroc-Jersey.

4. Where did these breeds originate?

All but the Berkshire were developed in America. Swine from Europe are not so well suited to this country.

5. What states developed these breeds?

The Poland-China originated in Ohio; the Chester-White in Chester County, Pennsylvania; the Duroc-Jersey in New Jersey.

6. What makes the Duroc-Jersey especially popular?

The breed is liked throughout the country because of the large litters of pigs together with the good size and quick growth.

7. What are the chief bacon breeds?

The Yorkshires and Tamworths.

8. What are the chief characteristics of lard hogs?

Lard hogs have large hams and shoulders, short bodies, and broad backs and necks. They have deep layers that contain a large amount of lard-bearing tissue.

9. What are the marked qualities of the bacon hogs?

They are long in body, deep in sides, with rather narrow back, light hams and shoulders. They have

strong muscular development and furnish choice hams and bacon.

10. Why should every farm have some hogs?

Because hogs will eat any kind of slops or waste that other stock refuse, and they produce meat more cheaply than other stock. They do not require such careful housing as other stock.

11. What proportion of live weight will they dress?

Hogs "dress out" from seventy to eighty-five pounds per hundred live weight.

12. What are some of the advantages of hog raising?

A brood sow may produce from four to twenty pigs a year so the cost of a pig is less than that of a calf or a lamb. Hogs have large litters that mature quickly and do not require expensive shelter. They require less care than cattle to produce an equal income.

13. What are some of the disadvantages of hog raising?

They use but little roughage and need a great deal of grain. They are likely to die in large numbers from disease.

14. What may be expected annually from a good brood sow?

She will, if desired, produce two litters a year of from six to ten pigs. Fourteen pigs each weighing 200 pounds at eight months make 2,800 pounds, which at five cents per pound makes an annual income of $140.

15. Can hogs be vaccinated against cholera?

Yes, cholera may be prevented by vaccination, but it is quite expensive.

16. How does hog cholera spread?

The germs are carried by diseased hogs, on men's clothes, by dogs, and by running water.

17. What measures of prevention may be taken?

Keep hogs well fed in clean, healthful quarters, with opportunity for exercise and they will better resist disease.

18. What shall be done in case cholera breaks out?

Dispose of all hogs not infected, or separate the hogs into several bunches and keep these groups a considerable distance apart.

19. What special care should be given a brood sow?

They should have plenty of succulent and muscle-forming food, but not be overfed. They need plenty of exercise apart from other hogs. It is well to let them have the run of a good pasture with only grain enough to keep them in a thrifty condition. They must not get too fat.

20. If only one litter of pigs is raised a year, when should they come?

Early in the spring. This does away with expensive housing as they will need shelter only for the summer.

21. Do sows raising two litters a year need more shelter?

Yes, in that case good, warm quarters are needed, though they need not be expensive.

POULTRY

1. Why do many farmers regard poultry raising as a small business?

   Because the profit comes in a little at a time.

2. How does the annual poultry product of the United States compare with the dairy product?

   The poultry product is the greater. It brings in to the farmers millions of dollars annually.

3. About what is the annual average income of the general farmer from poultry?

   It ranges from $60 to $150 per farm each year, with an average of about $100.

4. What is the best breed of poultry?

   Different breeds suit different conditions.

5. How are chickens classified?

   In three classes: egg breeds, meat breeds, and general-purpose breeds.

6. Which are the egg-producing breeds?

   Leghorns, Minorcas, Spanish, and Andalusians.

7. Name the meat-producers.

   Cochins, Brahmas, and Langshans.

8. Give the general-purpose breeds.

   Plymouth Rocks, Rhode Island Reds, and Orpingtons.

9. How can one get eggs in winter?

   By supplying, as nearly as possible, summer conditions.

10. How make hens exercise in winter?

By throwing the grain in loose straw or litter with fine sand under it.

11. What substitute for the bugs and worms of the summer bill-of-fare?

Scraps of meat and ground bone will take the place of insects.

12. How can one furnish the green feed of summer?

Cabbages, beets, or potatoes will supply this need; also mangels and carrots.

13. What other requirements are necessary?

Grit must be provided to aid in grinding the food, and crushed oyster shell will supply lime for the eggshells.

14. What protection from cold do hens need in winter?

The house should be kept warm enough to keep their combs from freezing and they should be protected from drafts of cold air.

15. How can this be done and still provide ventilation?

By muslin-covered open windows and, in extreme weather, a muslin curtain closing in the roost.

16. What is the best way to fight lice?

By dust baths and by whitewashing the building twice a year and spraying the roosts frequently with kerosene.

17. What may be said of the location of the poultry house?

It should be on well-drained soil with ample yards

where some protection is afforded from the north and west winds by a hill, a dense evergreen grove, or a building.

18. What directions may be given for the size of the poultry house?

Not more than fifty hens should be kept together, and they can be housed in a space sixteen feet square.

19. What is the usual shape of a poultry house?

They are usually made from twelve to eighteen feet wide and as long as is needed for the flock. A house eighteen by thirty-two feet will house one hundred chickens if it is kept well cleaned.

20. Why is light very necessary in the poultry house?

Sunlight is the strongest known enemy of germs, so all farm animals should have light quarters. The poultry house should be so arranged that the sunlight will reach every portion of it some time in the day.

21. What is the ratio of window space to floor space?

One square foot of window to every sixteen or twenty square feet of floor. The windows should be on the south, high enough to permit light to reach the north side of the coop.

22. What is a good ration for laying hens?

For one hen one day .175 pounds wheat, .07 pounds ground bone, .022 pounds cabbage, with plenty of fresh water, grit, and oyster shell.

23. What is the danger from feeding corn?

Corn is fattening and mature hens may soon get too

fat to lay. Where corn is fed it should be given at the evening meal to keep the chickens warm.

THE FEEDING OF STOCK

1. Of what use is food to the ox?

   It builds up his body, warms him, and furnishes him with energy or motive power?

2. Where does this energy come from?

   The energy comes from plant life.

3. From where do the plants get it?

   From the earth and the sun's rays.

4. Does nutrition, or the building up of the bodies of animals, differ from that of man?

   No, the foods are masticated by the teeth and digested in the stomach and intestines.

5. Are the digestive tracts of all animals alike?

   No, they differ; but each is adapted to the classes of substances the animal feeds upon.

6. What is peculiar about the digestion of birds and fowls?

   They swallow their food whole without chewing. It passes first into the crop, where it is stored, and softened by soaking, and then into the gizzard.

7. Of what use is the gizzard?

   It is a thick-walled, muscular stomach whose powerful muscles break up the food.

8. What is the chief difference between the digestive tract of the horse and the ox?

The horse has a comparatively small, single stomach, while the stomach of ruminating animals has four parts or compartments.

9. What are the ruminating animals?

The chief ones on the farm are the cattle, sheep, and goats. They chew the cud and have split hoofs.

10. Do ruminating animals chew the grass before swallowing?

When a sheep or cow bites off a bit of grass, it is moistened with saliva and swallowed without chewing, passing into the first stomach, or paunch, which is merely a storehouse.

11. When do ruminants chew their coarse food?

When they become quiet they regurgitate, or send back into the mouth, the balls of grass, called cuds, which are slowly ground fine between the teeth.

12. What then becomes of the finely-ground cuds?

They are again swallowed and pass into the second stomach, from there into the third, and then into the fourth, or true stomach, where digestion begins.

13. Do ruminants digest food more thoroughly than the horse?

Yes, they digest a larger part of the foods than the horse, because they chew their food finer and take a longer time to digest it.

14. Do ruminating animals fed on grains alone chew the cud?

No, they do not.

15. Is there any truth in the idea of "losing the cud"?

There is no such thing as losing the cud.

16. How many stomachs, or digestive sacs, has the horse? The pig?

The stomachs of both the horse and the pig have but one sac.

17. Does wetting, steaming, cooking or fermenting foods before feeding pay?

No, this practice has declined. It is thought now that such treatments of foods have no favorable influence.

18. Do animals get any part of their food from the air as do plants?

They do not.

19. What are the different nutrients in feeds?

There are five. They are proteids, fats, carbohydrates, mineral matters, and water.

20. Of what use are the proteids?

They form the tendons, muscles, gristle, hair, and hoofs and supply the proteids of blood and milk as well as that in the whites and yolks of eggs.

21. What foods furnish fuel or heat for the body?

The chief heat-giving foods are carbohydrates and fats.

22. What foods are burned in the body for heat?

Starches, sugars, and fats are oxidized, that is: burned in the body for heat just as coal is burned in a stove for heating or steam power.

23. Upon what does the usefulness of a food depend?

Upon the amount of nutrients it contains in a digestible form.

24. Is it sufficient to know the proportions of proteids, carbohydrates, and fats in food?

No, one must also know what per cent is digestible.

25. What is the "nutritive ratio"?

It is the ratio of digestible proteids, or flesh-forming nutrients, to the digestible heat-forming substances.

26. How does fat compare with carbohydrates for heat production?

Fat has two and one-fourth times as much heat energy per pound as carbohydrates.

27. How is the "nutritive ratio" estimated?

The digestible fats in grams is multiplied by two and one-fourth and the product added to the grams of digestible carbohydrates, thus giving the heat energy. The ratio of this to the grams of digestible proteids is the "nutritive ratio."

28. Should the ratio be the same for all animals?

No, animals at heavy work, when the muscle materials are being used up, require, relatively, more proteids than when the same animals are at rest.

29. What other animals require foods rich in proteids?

Young growing animals require plenty of building material or proteids as do animals producing milk, eggs, or wool.

30. When is a food balanced?

When the proteids and heat-producing substances are supplied in about the same ratio or proportion that they are consumed by the animal.

31. Does an unbalanced ration do harm to the animal?

No, but if the proportion is not right the animal may be using expensive proteids to supply heat or energy. It does, however, tax digestion unnecessarily.

32. What are the cheapest energy-producing foods?

Starchy foods will supply heat and muscular energy cheaply.

33. What is a deficient ration?

It is one on which the animal loses weight.

34. What is a maintenance ration?

It is one that allows just enough to keep the animal in good health without loss or gain.

35. What is a growing ration?

It is one that is sufficient to maintain the animal and provide a regular gain in weight.

36. What is a work ration?

It is one that will sustain an animal at work without loss of weight or vigor.

37. What is roughage?

Substances like hay and straw which contain a large per cent of indigestible matter, are called forage or roughage.

38. What are concentrates?

Those foods like grains and cottonseed meal, which are nearly all digestible, are called concentrates.

39. How do horses and ruminating animals differ in the amount of roughage?

Horses need about one-half of roughage, while ruminants need two-thirds of their rations to consist of roughage.

40. Is it ever wise to feed on concentrates alone?

No, because it cannot be digested thoroughly and disorder follows.

41. Do animals with a balanced ration ever need a change?

Yes, a change is relished by stock as by man.

42. What caution is necessary in changing rations?

The change should be made gradually.

43. Why are green feeds advisable in the winter?

Because animals relish the variety and green food aids the digestion of other foods.

44. How often do animals need salt?

It should be placed where they can get it every day.

45. How should it be supplied?

Under a shed to prevent waste from rains.

46. Do some animals need more than others?

Ruminating animals like sheep and cattle need it more abundantly than horses.

47. Why should dairy cows especially have plenty of salt?

Because it aids digestion, improves the appetite, and lessens danger from disease.

48. Is grinding grain for feed advisable?

Several experiments have been made. In three trials with horses using both corn and oats, grinding caused

an increase in digestibility of from three to fourteen per cent.

49. Is grinding profitable?

It depends upon the cost of grinding. If the miller takes one-tenth toll the practice is of doubtful economy. But if the farmer has a gas engine it will be profitable to grind grain for feed.

50. How does the animal use heat energy?

In muscular activity such as working, walking, breathing, the beating of the heart, the movements of the stomach and intestines.

51. What becomes of the feed given, over and above the maintenance ration?

The Hereford steer deposits it in steaks and thick quarters, the dairy cow makes of it the fat, sugar, and curd of milk.

52. How many pounds above maintenance should be given a dairy cow?

It depends on the cow. Some will not pay a profit on more than three or four pounds, while others may be given with profit twelve or fifteen pounds.

53. Is this difference all in the breed?

No, in every herd there are "good feeders" and "poor feeders," and the intelligent farmer breeds only from the former.

54. How does one begin to fatten hogs or steers?

By beginning with light rations and increasing gradually until the stock are on full feed.

55. What effect has shelter on feeding?

Shelter reduces the amount of feed. Exposure reduces the milk of dairy cows and the eggs of laying hens. Exposure uses up the animal's energy and it thus requires more food.

56. In fattening steers for market, what is a good daily gain?

An average of two pounds live weight per day for a long period is satisfactory.

57. What is the fat-forming food?

Carbohydrates.

58. Is there much need of protein here?

No, the amount of protein needed for fattening mature animals is very small, almost nothing.

59. How much and what kind of feed can be fed daily with profit to a 1,000-pound steer?

From 8 to 10 pounds of coarse food, dry, and from 15 to 18 pounds of grain.

60. Will this ration suit steers smaller and larger than 1,000 pounds?

Those smaller need more feed per 1,000 pounds live weight, and very heavy steers need less than this amount per 1,000 pounds.

61. What are the two important things to keep in mind in fixing the ration?

The ration should be palatable; that is, stock should like it, and it should be composed of a variety of easily digested materials.

62. Give three well-balanced rations, or mixtures, for 1000-pound steers.

(1) 5 pounds clover hay, 16 pounds corn silage, 13 pounds corn meal, 3 pounds of bran.

(2) 8 pounds alfalfa hay, 12 pounds corn meal, 5 pounds ground oats.

(3) 8 pounds mixed hay, 12.5 pounds corn meal, 3 pounds wheat bran, 2 pounds oil meal or gluten food.

63. About how much feed is needed daily for fattening sheep per 1000 pounds live weight?

Sheep need relatively more than cattle—about 21 pounds per 1000 pounds live weight.

64. Give a mixture for feeding sheep.

Eight pounds oats, 8 pounds corn, 2 pounds bran, 1 pound oil meal.

65. Which is more profitable to the farmer, to place his pigs on the market weighing from 300 to 400 pounds or weighing from 100 to 150 pounds?

The earlier selling at a weight of about 150 pounds pays better. It requires more hogs to be raised to produce the same income.

66. What makes a good mixture or combined feed for growing swine?

Cereal grain, supplemented by skim milk and buttermilk.

67. What is the most economical mixture?

One pound of corn meal to one-third pound of skim milk; but if there is abundance of milk it can be made

to replace corn. Then the best result will probably be 1 pound of grain to 2 pounds of skim milk.

68. What protein feeds are adapted to pigs?

Gluten meal, gluten feed, buckwheat middlings, peas and middlings.

69. What carbohydrates are suitable?

Oats, barley, wheat, rice products, and especially corn are useful.

70. Is it profitable to feed forage crops to pigs?

When fed with grain good results are obtained. Grain is needed to balance the ration.

71. What forage crops are adapted to pigs?

Clover, alfalfa, rape, sorghum, rye, and ordinary pasturage are all found to be adaptable to hogs.

72. What is a good mixture for colts?

Corn, two parts; oats, four parts; bran, three parts; oil meal, one part.

73. Should colts be given roughage?

Yes, a reasonable amount of coarse feed to develop the alimentary canal, or digestive organs.

74. Is it possible to increase the fat or cream of milk by feeding richly of fats to cows?

No, it has been tried often, but with failure.

75. What is a good daily ration for a resting 1000-pound horse?

(1) 16.5 pounds of medium mixed hay; or (2) 10 pounds timothy hay and 5 pounds oats; or (3) 10 pounds timothy hay and 4 pounds of cracked corn.

76. How much milk may a high-grade cow give annually?

Record cows have given 26,000 pounds of milk in a year. This high record, however, can not be expected from a herd of even the best breed.

77. How many pounds of digestible organic food should a good cow have daily?

A good cow of average size should have about sixteen pounds daily.

78. How does the ration for milch cows differ from that of steer maintenance?

The cow needs much more protein; about two and one-fourth pounds of protein daily.

79. Give two examples of well-balanced rations for good cows.

(1) 10 pounds clover hay, 35 pounds corn silage, 2 pounds hominy chops, 4.5 pounds wheat bran, 2.5 pounds linseed meal.

(2) 10 pounds mixed hay, 40 pounds corn silage, 4 pounds wheat middlings, 3 pounds malt sprouts, 1 pound gluten meal.

80. What is the best stable temperature in winter?

Temperature should be above 45 degrees Fahr., and it may well be below 60 degrees.

81. What other stable precautions are necessary?

The stable should be well ventilated without having cold-air currents blowing on the animals.

82. Is it wise to keep cows tied in one spot for months at a time because exercise costs food?

All animals need exercise for health and vigor, even though it does cost a little extra feed.

83. Does kindness to animals have a money value?

Close observers declare that it does, especially with dairy cows.

COUNTRY ROADS

1. What is the value of good roads?

They have a social value, encouraging travel and sociability; and an educational value, encouraging attendance at schools at a distance, also at churches and at lectures.

2. What is the economic value of good roads?

They reduce the cost of marketing farm products.

3. In what sense do poor roads cost more than good ones?

Poor roads either add to the cost of the product for the consumer or reduce the profits of the farmer.

4. Why should city people be taxed to make good roads?

Because the better the roads the more produce will be hauled in from the farm, making it cheaper in price.

5. What is the usual width of roads?

In the Central West they are two rods, or thirty-three feet, in width.

6. Why is this width necessary?

To enable teams to turn, as well as to allow space for ditches, cuts, and fills.

7. Which is the better way for farmers to pay road tax, by working it out or paying it in cash?

   The cash system is better.

8. Give reasons.

   Cash enables competent road men to be employed to make all repairs, and these can be made whenever needed instead of only in the summer, as is the case when farmers work out a road tax.

9. What is a macadam road?

   It is a hard stone-made road, named for a Scotch engineer by that name.

10. How is a macadam road made?

    The roadbed is first given the proper slope, then covered with a layer of coarse crushed rock, which is rolled with a heavy roller. Then another layer of finer crushed rock is placed on top and rolled well into the coarser underlayer. The last layer is of still finer material, covered with sand, both sand and material being separately rolled to a smooth hard surface.

11. What does a macadam road cost per mile?

    It varies from $3000 to $6000 per mile, according to the distance necessary to draw or transport the stone.

12. What is another problem of roadmaking besides the surface?

    Proper drainage. A small rill or stream will soon do serious harm to any good road surface, therefore the road should have a good slope and the ditches must be clear.

13. What is the most necessary tool for keeping dirt roads in order?

A split-log drag.

14. How is it made?

With two halves of a log fastened some feet apart by cross pieces, so the sharp edges of the log will smooth off the road as it is dragged along, the dirt from the high places being drawn into the depressions.

15. When is the best time to drag a road?

After a rain by driving up one side of the road and back on the other, covering one rut in each case. Riding on the outer, or ditch-end of the drag, forces the loose dirt to the center of the road, thus giving it the slope needed.

16. What good results from such dragging?

Ruts are filled up and less chance is offered for standing water or puddles; the ridges are smoothed off and the surplus loose dirt is pushed to the middle of the road, making a better slope.

17. What is the average cost of overland transportation of farm products?

According to investigations, hauling costs 1.4 per cent of the value of cotton, 2.7 per cent of wood, 7.2 per cent of wheat, 7.7 per cent of oats and 9.6 per cent of the value of corn.

18. What was found to be the average cost per ton mile?

Reports including all kinds of roads from all parts of the country give an average of 25 cents per ton mile.

19. What is the difference in cost of hauling over good roads and bad ones?

The cost per ton mile over good stone roads is 8 cents, over earth roads, containing ruts and mud, 39 cents; over dry, sandy roads, 64 cents.

20. How does the road surface affect the draft of a horse?

A load that 3 horses are just able to draw on a level asphalt road would require 7 horses on a smooth block pavement, 14 horses on cobblestone, 40 horses on an ordinary earth road, and 80 horses on a dry, sandy road.

21. What is a 1 per cent grade?

One that rises 1 foot for every 100 feet of distance.

22. How does steepness of grade affect the draft of a horse?

When a horse can pull 1000 pounds on a level road he can draw only 900 pounds on a 1 per cent grade, 800 pounds up a 2 per cent grade, 400 pounds up a 5 per cent grade and 250 pounds up a 10 per cent grade.

23. What is the difference in narrow and broad tires on the draft?

There is no difference on hard roads, but narrow tires cut in dirt roads and thus reduce the draft.

24. How does the width of the tire affect the road?

Narrow tires injure roads, but wide tires roll and harden the roads like a roller.

PRESERVING FOODS

1. What causes the loss of canned goods?

   The presence of any one of three living organisms will cause decay of animal or vegetable matter—they are yeast, molds, and bacteria.

2. What conditions are conducive to the growth of yeast plants?

   They need warmth, air, moisture, and sugar.

3. How does the yeast plant grow?

   By budding, which means that the parent plant divides into two plants and these grow and divide, and the process continues as long as conditions are favorable.

4. Where will yeast easily grow?

   It will grow in fruit juice and fruit slightly sweetened, but not in thick sirups or preserves. It is easily killed by a high or a low temperature.

5. How does mold get a start?

   The spores or seeds of mold are very light and may be floating in the air. When they lodge on a warm, moist surface, such as food often presents, they germinate and cover the surface.

6. How may molds be destroyed?

   By exposure to a high temperature for about twenty minutes.

7. Where do bacteria grow most readily?

They multiply rapidly in meat, milk, and legumes, but will not grow in acids or thick sirups.

8. Which of these organisms injure canned and preserved fruits?

Such foods are more liable to be injured by yeast and molds than by bacteria.

9. What makes fruit juices form jelly?

Pectin, a carbohydrate resembling starch, is an important factor in the juice of ripe, or nearly ripe fruit. When equal amounts of sugar and fruit juice are mixed and heated, the pectin causes the mixture to gelatinize, thus forming jelly.

10. What are the chief essentials in canning and preserving?

Cleanliness and sterilization.

11. How is sterilization effected?

Kettles, jars, strainers, covers, rubbers, and all utensils to be used should be scalded or otherwise sterilized.

12. What general rules may be given for canning foods?

Kill all germs in the food and inside the cans and seal while hot, so as not to permit other germs from the air to enter.

13. Why does drying fruits and meats preserve them?

Germs or bacteria cannot grow without the presence of water.

14. Upon what principle is canning based?

It is based on the fact that exclusion of bacteria from organized matter will prevent decomposition or decay.

15. How may one know if living germs are in the canned foods?

It is known by the escape of gas, which indicates that decomposition, or fermentation, has set in. Such foods quickly spoil unless used or recanned.

16. Why does salting meat preserve it?

Because bacteria cannot live in a strong solution of common salt.

17. Does putting fruit and meat in cold storage kill the bacteria?

No, a low temperature simply keeps them from growing and multiplying. As soon as the temperature rises they begin to act and the food soon spoils.

18. How does smoking meat preserve it?

Smoking meat coats the outside with a thin layer of creosote, which not only kills all germs present, but gives the meat a different flavor.

19. Is any particular wood necessary to the successful smoking of meats?

No, the smoke of almost any wood will preserve meat, but some kinds give better flavor than others.

20. What effect has sugar upon keeping qualities?

Sugar is a preservative against the action of germs. It is used somewhat in curing meats and extensively in preserving fruits.

21. How is the process of preserving fruits explained?

Preserved fruits are cooked for a long time and this "boiling down" process kills all germs and drives off

the water, thus making conditions unfit for others to grow.

22. What makes milk sour?

Germs or bacteria.

23. Where do they come from?

The air is full of germs, the barn dust is laden with them, and there are some in the milk pail and on the hands of the milker.

24. How should milk cans and pails be treated?

All milk vessels should be thoroughly washed, scalded, and, if possible, placed in the sunlight, which is an enemy of germs, or, in other words, a disinfectant.

25. What causes butter to become rancid?

Bacteria.

26. How can this best be prevented?

By working out all the water which bacteria need and by mixing salt well into butter.

27. What is it that makes cider turn to vinegar?

Bacteria. The solid, slimy mass, known as "mother of vinegar," is merely a vast colony of bacteria.

28. What kind of cider makes the best vinegar?

Sweet cider, because it contains more sugar.

29. Where do the vinegar-making bacteria come from?

From the air and from the barrel. The process may be hastened by introducing mother of vinegar.

USEFUL INFORMATION

EVERY GIRL SHOULD KNOW HOW TO REMOVE STAINS

Tar or Wagon Grease. Cold soapsuds will remove most stains if used before the garment is dipped in hot water. For pitch stains, grease with lard before using soap and water. Turpentine will remove all such stains.

Grass. Remove grass stains when fresh if possible. Alcohol, naphtha soap and water, or ammonia and water will remove grass stains.

Ink. Wet the spot with warm water, apply sapolio, and rub gently between the hands, or wash in a solution of hydrochloric acid and rinse in ammonia water.

Mildew. Mix equal parts of soft soap and starch, half as much common salt and the juice of half a lemon, spread over the spots and lay the article on the grass for twenty-four hours or until the stain disappears.

Blood Stains. Fresh stains may be rubbed out after soaking in cold or tepid water. If very dry, use javelle water or peroxide of hydrogen. Kerosene in water will remove obstinate stains. Articles that cannot conveniently be washed, may be cleaned by making a paste of bulk starch and cold water, spreading on thickly and drying in the sunlight. When dry brush off and repeat process.

Iron Rust. Apply salt and lemon juice to the dampened spots and place in the sun or near the fire. Rinse thoroughly.

Fruit Stains. Pour boiling water over the surface, having it fall from a distance of three feet, or wring article out of cold water and hang out of doors on a frosty night.

If obstinate, diluted muriatic acid, javelle water, or sulphur fumes are good.

Meat Juice. Hot water will set the stain. Soak in cold water, wash in suds of cold water, and rinse in cold water.

Paint Spots. Equal parts of ammonia and turpentine will remove paint stains of long standing.

Tea, Coffee, or Cocoa. Wash in cold water, cover with glycerine, and let stand two or three hours; wash with cold water and hard soap. If stains are fresh, pour boiling water through from a height after soaking.

Perspiration. Soak in cold water, wash with borax, and expose garment to sunshine. Stains under the arms require an acid, such as a weak solution of muriatic acid.

Burned Cooking Utensils. To clean granite ware where mixtures have been burned on. Half fill with cold water, adding any good soap or washing powder; heat water gradually to the boiling point.

INSECTICIDES AND FUNGICIDES

FOR BITING INSECTS—POISONS.

1. Arsenate of Lead.

Arsenate of lead....................	2 to 3 pounds
Water, or Bordeaux, or lime-sulphur.....	50 gallons

Arsenate of lead is found on the market both as a powder and as a putty-like paste. The paste must be worked free in water before it is added to the lime-sulphur mixture or to the Bordeaux mixture. The paste form of the poison is used at the rate of two or three pounds to each fifty gallons of the liquid and is added to it after it has been well dissolved in water.

2. Wet Paris Green.

Paris green	¼ pound
Lime	½ pound
Water	50 gallons

If the above amount of Paris green is to be used with fifty gallons of Bordeaux mixture the half-pound of lime should be omitted.

3. Dry Paris Green.

Paris green	1 pound
Powdered lime	20 pounds

For Sucking Insects.

4. Kerosene Emulsion.

Strong hard soap, shaved fine	½ pound
Water	1 gallon
Kerosene or crude petroleum	2 gallons

The soap should be dissolved in the water by boiling, remove from the fire while still boiling hot and at a safe distance from the fire add the oil, stirring violently until it is thick like cream. If it is well made it will keep indefinitely and may be diluted when needed for use. During the growing time of summer, for plant lice and other soft-bodied insects, dilute the emulsion with fifteen parts of water; for the red spider and other plant mites, the same, with the addition of one ounce of flowers of sulphur to the gallon; for scale insects, the large plant bugs, and larvæ, dilute with from seven to ten parts of water. Apply with a spray pump.

5. Bordeaux Mixture—Used as a Fungicide to Prevent Diseases.

Copper sulphate (bluestone)	6 pounds
Unslaked lime	4 pounds
Water	50 gallons

Dissolve the copper sulphate at the rate of one pound of copper to a gallon of water. Slake the lime until it is thick like cream. This is a stock solution and may be kept covered until needed.

6. Lime-sulphur—to Kill San Jose Scale and Prevent Disease.

Powdered flowers of sulphur	15 pounds
Burned lime	15 to 20 pounds
Water	50 gallons

Add the wet sulphur and the slaked lime to ten gallons of boiling water. Boil for an hour or until well dissolved. Add water to make fifty gallons.

FERTILIZERS FOR DIFFERENT CROPS

THESE FORMULAS MUST VARY ACCORDING TO THE SOILS

Field Corn.

Ground bone	250 pounds
Acid phosphate	500 pounds
Muriate of potash	250 pounds

Apply 200 to 300 pounds to each acre on manured soils; 300 to 500 pounds on medium soils without manure. Increase nitrogen for forage corn or ensilage.

Oats.

Nitrate of soda	150 pounds
Tankage	200 pounds
Acid phosphate	600 pounds
Muriate of potash	50 pounds

Apply on good soils, 200 to 300 pounds to an acre; 300 to 500 pounds per acre on medium soils with manure.

Wheat.

Dried blood	150 pounds
Tankage	100 pounds
Acid phosphate	700 pounds
Muriate of potash	50 pounds

Apply same as oats.

Early Potatoes.

Nitrate of soda	100 pounds
Sulphate of ammonia	100 pounds
Tankage	100 pounds
Acid phosphate	500 pounds
Sulphate or muriate of potash	200 pounds

Apply from 500 to 1,200 pounds per acre.

Sweet Potatoes.

Tankage	300 pounds
Dried blood	100 pounds
Acid phosphate	400 pounds
Muriate of potash	200 pounds

Apply from 500 to 800 pounds per acre.

Early Tomatoes and Market Garden Crops.

Nitrate of soda	250 pounds
Ground bone	100 pounds
Acid phosphate	550 pounds
Muriate of potash	100 pounds

Apply 800 pounds per acre

Timothy Hay, Top Dressing.

Nitrate of soda	500 pounds
Ground bone	200 pounds
Acid phosphate	200 pounds
Muriate of potash	100 pounds

Apply 200 to 300 pounds per acre.

THE FARMER'S ARITHMETIC

One acre of land measures 160 square rods, or 4,840 square yards, or 43,560 square feet.

If the length of a field is known in rods, the width necessary to make one acre is found when the given length is divided into 160.

A ton of hay on a wagon rack measures about 500 cubic feet.

A ton of newly stored hay measures about 422 cubic feet.

After hay has settled several months it measures 270 cubic feet to the ton.

231 cubic inches make one liquid gallon.

2,150.4 cubic inches make one bushel.

This standard bushel is a cylinder 8 inches deep and 18.5 inches in diameter.

1.25 cubic feet are allowed for one bushel of shelled corn or grain.

2.25 cubic feet are allowed for one bushel of corn on the cob.

A crate 10x11x20 inches inside measurement is used for a bushel of onions, potatoes, or other vegetables.

Quantity of Seed per Acre and Legal Weights per Bushel

Alfalfa	30 lbs.	60 lbs.
Barley	8 to 10 pks.	48 lbs.*
Blue Grass	20 to 25 lbs.	14 lbs.
Buckwheat	3 to 5 pks.	48 lbs.*
Clover	10 to 15 lbs.	60 lbs.*
Corn, shelled, check row	6 to 8 qts.	60 lbs.
Corn, ensilage	10 qts.	
Cotton, upland	4 to 8 pks.	32 lbs.*
Cowpea	4 to 7 pks.	60 lbs.
Oats	2 to 3 bu.	32 lbs.
Potato	6 to 18 bu.	60 lbs.*
Rye	3 to 8 pks.	56 lbs.*
Timothy	10 to 20 lbs.	45 lbs.*
Wheat	6 to 9 pks.	60 lbs.

Distances Apart for Planting Fruit and Vegetables

	Feet
Apples	30-40
Apricots	15-20
Cherries	15-25
Oranges	25-30
Peaches	15-20
Pears	20-30
Plums	15-20
Quinces	10-12
Blackberries	4.5-7
Currants	4-4.5
Gooseberries	4-4.5
Raspberries	3.5-5
Strawberries	1-4
Asparagus	3-4
Beans, bush and pole	2-4
Beet	1.5-2

	Feet
Cabbage	2-3
Carrot	1.5-2
Corn, sweet	3-3.5
Celery	3-4
Lettuce	1-2
Onion	1.5-2
Parsley	1-2
Peas	1-3
Potato	2.5-3
Radish	1-1.5
Rhubarb	4
Salsify	1.5-2
Squash and pumpkin	6-8
Turnip	1.5-2
Tomato	3-4

*Varies in a few states.

AGRICULTURAL BULLETINS

Each school may secure a good library of agricultural bulletins at small expense. Write to the Secretary of Agriculture, Washington, D. C., asking that your school be placed on the mailing list to receive the monthly list of bulletins. Ask also to have sent one copy of each of the following:

Circular No. 4, Division of Publications.
Farmers' Bulletin Subject Index.
List of Publications for free distribution.
List of Publications for sale.

Those pamphlets on the list for free distribution will be sent to any one for the asking. Those listed for sale may be purchased at slight cost, or perhaps some of them may be secured through your Congressman. Write to your State Experiment Station (See p. XXV) for the list of state bulletins for free distribution and ask to have your name placed on their mailing list. A few of the many farmers' bulletins to be obtained from the Secretary of Agriculture are given below:

Horse, Nos. 170, 222; Cattle, 106, 71, 233; Milk and Butter, 55, 42, 63, 251; Swine, 100, 133, 205, 272; Poultry, 51, 186; Turkeys, Ducks, and Geese, 64, 200; Insects, 127; Bees, 59, 397; Birds, 54; Soils, 44, 187, 192, 245; How Plants Grow, 157; Corn, 199, 229, 253, 313, 409; Potato, 35; Hay, 89, 339; Orchards, 87, 113, 283; Gardens, 154, 218, 255; Sanitation, 155.

LOCATION OF STATE EXPERIMENT STATIONS

Any letter addressed to the "Experiment Station" with proper post-office address will reach the institution.

Alabama—Auburn or Uniontown or Tuskegee.
Arizona—Tucson.
Arkansas—Fayetteville.
California—Berkeley.
Colorado—Fort Collins.
Connecticut—New Haven or Storrs.
Delaware—Newark.
Florida—Gainesville.
Georgia—Experiment.
Hawaii—Honolulu.
Idaho—Moscow.
Illinois—Urbana.
Indiana—Lafayette.
Iowa—Ames.
Kansas—Manhattan.
Kentucky—Lexington.
Louisiana—Baton Rouge.
Maine—Orona.
Maryland—College Park.
Massachusetts—Amherst.
Michigan—East Lansing.
Minnesota—St. Paul.
Mississippi—Agricultural College.
Missouri—Columbia or Mountain Grove.
Montana—Bozeman.
Nebraska—Lincoln.
Nevada—Reno.

New Hampshire—Durham.
New Mexico—Agricultural College.
New York—Geneva or Ithaca.
North Carolina—Raleigh.
North Dakota—Agricultural College.
Ohio—Wooster.
Oklahoma—Stillwater.
Oregon—Corvallis.
Pennsylvania—State College.
Rhode Island—Kingston.
South Carolina—Clemson College.
South Dakota—Brookings.
Tennessee—Knoxville.
Texas—College Station.
Utah—Logan.
Vermont—Burlington.
Virginia—Blacksburg.
Washington—Pullman.
West Virginia—Morgantown.
Wisconsin—Madison.
Wyoming—Laramie.

The United States Department of Agriculture is located at Washington, D. C. Address the Secretary of Agriculture.

REFERENCE BOOKS FOR TEACHERS

First Principles of Soil Fertility. A. Vivian ($1.00), Orange, Judd Co.

Bacteria in Relation to Country Life. J. G. Lipman ($1.50), Macmillan.

Cereals in America. T. F. Hunt ($1.75), Orange, Judd Company.

Forage and Fiber Crops in America. T. F. Hunt ($1.75), Orange, Judd Co.

Manual of Gardening. L. H. Bailey ($2.00), Macmillan.

The Principles of Fruit-growing. L. H. Bailey ($1.50), Macmillan.

The American Apple Orchard. F. A. Waugh ($1.00), Orange, Judd Co.

The Potato. S. Frazer ($1.75), Orange, Judd Co.

Feeds and Feeding. W. A. Henry ($2.00), W. A. Henry, Madison, Wis.

Types and Breeds of Farm Animals. S. C. Plumb ($2.00), Ginn and Co.

BOYS' AND GIRLS' AGRICULTURAL CLUBS

Canning Tomatoes at Home and in Club Work. Farmers' Bulletin No. 521 (U. S. Dept. of Agriculture).

Special Contests for Corn-Club Work. Bureau of Plant Industry, Circular No. 104 (U. S. Dept. of Agriculture).

Organization and Instruction in Boys' Corn-Club Work. Bureau of Plant Industry, Circular No. 803.

NOTE.—For Agricultural Club Organization Blank Forms, address

U. S. DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry
Office of Farm Management—Club Work
Washington, D. C.

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All figures refer to pages; heavier type is used for the more important references